BRICKLAYING
IN MODERN PRACTICE

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BRICKLAYING

IN

MODERN PRACTICE

BY

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WISCONSIN

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PREFACE

BEFORE a man can run he must learn to walk. This statement involves a principle often neglected in the educational field. We live in an industrial era the characteristic feature of which is division of labor. Very frequently, however, we find that trade and technical books do not sufficiently recognize this division of trades and labor in the industries of which they treat. In preparing the present work the author has kept in mind this principle, that when a boy has entered a mechanical pursuit he should master the fundamentals of that trade and not confuse his mind with a variety of other related problems. Bricklaying to-day is an independent trade, and before a bricklayer should expect to master related trades, or to obtain an adequate acquaintance with an advanced field, such as architecture or engineering, he should learn to do well the thing that is in his hand to do, and to use that as a stepping-stone to further achievement.

Most textbooks give a large proportion of space to a variety of subjects which do not further the declared purpose. In this work we have not attempted to present a "royal road to fortune", and neither do we give the boy the impression that he can become a skilled mechanic by any overnight process. This text is devoted to the bricklaying trade and its purpose is to present such information as will help to make a bricklayer an intelligent mechanic and a good citizen as well as to furnish him with an outline of the subjects essential for skill in his trade.

It is hoped that this work will be serviceable not only to the boys learning the trade but to others who have not yet entered a trade and wish to know something about it, *i.e.*, for pre-apprenticeship work. However, it should form a basis for study in the apprenticeship schools which are already established for apprentices in this trade.

The author has prepared a glossary at the close of the book which the learner should consult freely so that he may have an accurate knowledge of the technical terms used in this work.

The author wishes to acknowledge indebtedness to friends who have given valuable suggestions, particularly to Mr. J. E. Ray of Stout Institute, Menomonie, Wisconsin, for assistance in preparing Chapter V, to Mr. W. L. Hess, Milwaukee, Wisconsin, for assistance in preparing Chapter VI, and to Mr. John Callahan, State Director of Vocational Education for Wisconsin, for reading the manuscript and for valuable suggestions. Moreover, the author is greatly indebted to Dr. Richard T. Ely for inspiration and encouragement in the work and for the kindly counsel of his ripe experience.

STEWART SCRIMSHAW.

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CHAPTER I

THE ANCIENT ART

BRICKLAYING is often spoken of as the ancient art. This fact is worthy of notice in the beginning of any acquaintance with this trade. Why is it called an art? The answer can be given only when we understand what an art really is. When one speaks of an art one has in mind something that is done with skill, work that requires adept performance of the hands, adaptation through the trained eye, and the intelligent direction of the mind.

In bricklaying it is necessary to have skill of the hand in using the trowel, in spreading mortar, and in handling bricks. A trained eye is necessary to lay the bricks according to the line used for a guide in building the wall; to build the corner square and plumb, to judge thickness in spreading mortar, and to gauge the width of joints in brickwork. A trained eye is necessary to maintain the correct bond; that is, to place the bricks so that they will overlap the course below in such a way as to give the appearance of good workmanship, as well as to be in reality workmanlike.[1]

[1] The reader should consult the glossary for all technical terms which he does not fully understand.

Next to getting something to eat, man usually desires shelter. Man must protect himself from the heat, the rain, and the cold. Naturally, therefore, before any civilization develops man begins to build shelter if only in the hills and in the rocks. As civilization has grown, this building of shelter has received more and more attention, and the varieties of material used have been more and more numerous, until the possibilities of modern dwellings have been developed. From a crude beginning the art of building has grown from the ability to make mud huts to the power to create the wonderful buildings such as we see around us everywhere to-day. Too often we take things for granted; too often we forget that everything had a beginning. There was a time when man did not know how to lay bricks, a time when he did not know how to make bricks. There was a time when fortresses and cathedrals were unknown, and churches and residences were not to be seen on the face of the earth. But to-day we see wonderful architecture, noble and glorious structures, magnificent skyscrapers, and pretty home-like bungalows — all because this ancient art has been practiced from generation to generation, handed down from father to son, and achieved through the toil of countless millions, fostered by the cultivated brain of man throughout all the centuries.

A young man who has begun to learn the art of bricklaying should swell with just pride at his choice. How zealously should he preserve the highest standards of the trade's perfection! How determined should he be to live up to the noble traditions of the long past! How conscientiously should he strive to learn of its mysteries, and in a time when beauty in form and perfection in workmanship may be temporarily sacrificed for immediate practical gain, how constantly should he, as a real mechanic,

endeavor to keep alive the best practices of his trade! And he may be certain that the present-day neglect of some of the finer parts of the trade will before long give place to the growing demand in America for the more artistic in form, the more beautiful in appearance, and the more excellent in quality of workmanship.

In Egypt, many thousands of years ago, bricks were used, and we read in the Bible, in the book of Genesis, that the Israelites were punished because they did not make more bricks without straw. This is not so strange as it seems, for in those days bricks were made of the combination of mud and straw. Old Egyptian tombs have been unearthed which date back 7000 years, and these tombs are built of bricks. During those times the walls of houses were at least two feet thick, although the size of the bricks did not differ very materially from that of the modern bricks. They were a little larger but in the same proportions as ours.

The first bricks that we know about were, as already indicated, the mud and straw bricks and these had to be burned in the sun. Later it was found that in order to withstand excessive wet and damp, additional burning was necessary, and from that has developed the process of burning clay to make bricks hard and durable. Perhaps the most significant building with bricks in the most ancient times was in Babylonia, for on the plains of Babylon the art of brickbuilding reached a relatively high stage of development. In Babylonian times immense walls of brick surrounded the cities. Babylon, itself, had a wall nine miles around, eighty-five feet high, and three hundred and forty feet thick.

About 6000 years ago the second city built upon the hill of Troy, which we have all read about in our mythology, was made of bricks. The kind of bricks used for

this city was the same as that employed by the earlier Egyptians. To-day when we admire the splendid glazed tile we see so often, we are not likely to realize that in Egypt 5000 years before the birth of Christ, glazed tiles were used, although glazed bricks, as we know them to-day, were not used until 900 years before the birth of Christ.

Strange to say, in these earlier times more attention was given to the construction of brickwork than is given in our own country at the present time. The many difficulties arising from the imperfect bond were well known, and every precaution was taken to secure the perfect bond, durability, the greatest possible strength, and the utmost imperviousness, or ability to withstand wet and moisture. In ancient Babylon particularly, the city by-laws governing construction work were very severe. Strange it is that in many of our cities to-day people engaged in the building craft are often found who consider it an unjustifiable interference of government when regulations are made stipulating the kind, quality, and fitness of buildings which are planned for erection. In the city referred to, if a house or any part of a house, or other structure, fell down and killed the owner, the builder was put to death. If it killed the owner's son, the builder's son was put to death. If one or more of the owner's slaves (the workers were slaves in those days) were killed, the builder had to restore him slave for slave besides heavy compensation for any damage to his goods, and rebuilding the house or the part which had fallen.

The art of bricklaying was extensively practiced by the ancient Greeks. All schoolboys have heard of the ancient walls, fortresses, and viaducts which were built with brick in the old Roman Empire. One can to-day see in every part of Europe ancient bridges built of brick, and old castles still intact as well as many other admirable pieces

of workmanship in brickwork, that are the admiration of all intelligent tourists.

In the Middle Ages building was esteemed one of the noblest crafts, and many of the magnificent cathedrals which are standing in Europe to-day are a living witness to that fact. Every brick, every stone in the building was placed with such a degree of accuracy and with such a spirit of devotion, as to suggest the idea that the craftsmen who did the work felt that they were rendering a signal service to the Creator of all art. Even in the most obscure places in the building no part would be neglected, no attempt would be made to "slip something over", for the workmen of those days always remembered that there was an All-Seeing Eye who could detect the flaws in their work. The men of those days engaged in building were united into what were known as craft guilds. These craft guilds were made up of both masters and journeymen. Great emphasis was placed upon skill, upon quality of workmanship, and upon honorable dealings one with another. It is significant that the wonderful institution known in these modern days as "Symbolic Masonry" grew out of this noble art of building which brought together in the early days all the men in a trade. Their lives were devoted to the earnest performance of their work, to the development of character, while they strove to make themselves exemplary citizens in the communities in which they lived. It is out of this heritage of the past that the bricklayer comes, and so glorious a past is it that the modern mechanic, skilled in the art of bricklaying, is able by a study of these ancient practices to gain knowledge that will assist him in the proper performance of the trade which he has chosen as a means to a livelihood.

The writer is aware that in America to-day the art of

bricklaying does not seem to measure up to these glowing pictures which portray what happened in the trade long ago. This condition is a perfectly natural one and is a result of the newness of our western world. However, conditions are rapidly changing. When our forefathers came to the shores of America there was a generous supply of timber on every hand, and all that was necessary to make a house secure from the severe climate of New England was to cut down trees and build them into thick walls which could resist every kind of weather. Moreover, should the colonists have desired to build with brick there were no brickmakers available. Not until 1634 was the first brick house built on the American continent. That was erected in the town of Medford, Massachusetts, by Governor Craddock, of Massachusetts Bay Colony, and the bricks that were used were brought from Europe. This house has stood as a monument to the durability of brick for almost three centuries.

So far as we know, the first brick in America was made in the New Haven Colony in 1650, but very little was manufactured until after the Revolution. Although brick was not extensively used, yet the most sacred monuments which we have of those early historical days were brick structures. Is there an American who does not contemplate with just pride those shrines of our ancestors, — the Betsy Ross House, the old home of William Penn, Independence Hall of Philadelphia, the old State House and Faneuil Hall of Boston? It has been possible to hand these monuments down as an inspiration from generation to generation because they were built of bricks. But although these buildings stand out with such rare prominence, the fact remains that until recent times wood was practically the only material that was given consideration in the ordinary building. It was only the

pretentious houses of the rich, or the important commercial buildings that were built of other material, for in such buildings as these brick has usually been predominant. To-day, however, things are changing, for conditions which made wood the most economical building material are passing. The sources of timber within the reach of the great centers of population are being rapidly depleted. Lumber must now, in many cases, be hauled hundreds, and even thousands, of miles, to market. The scarcity of timber and the high cost of its transportation have taken from wood construction the only virtue which the bricklayer is apt to think it ever possessed, *i.e.*, cheapness. The forests are now being cleared of timber, and mother earth is being resorted to more and more to furnish the material out of which man can build for purposes of home, business, and worship.

How strong the movement away from timber in construction really is, can be judged from the efforts made to produce concrete as a universal building material. Concrete, being a simple combination of sand, gravel, and cement, is relatively easy to make, and this fact has caused many attempts to employ concrete in places where its use is not justified by experience and utility. Many bricklayers, for instance, have thought of concrete as a substitute for brick. Concrete, in reality, is a supplement to brick construction. As a building material it is a competitor of structural steel rather than of brick. Concrete fortunately affords a wider use for brick, for while concrete may be used for foundations and reënforcements, brickwork must be resorted to for the neat and artistic in appearance, to say nothing of the added advantage of durability of the structure. For outside surfaces concrete should not be used extensively, because its color is lifeless, and because it has scarcely any adaptability to

change and artistic arrangement. There is satisfactio to the bricklayer in the fact that the more concrete i used, the more brickwork will be demanded, especiall for facing, therefore requiring more artistic perfectioı on the part of the bricklayer. The demand for bette face work will, moreover, result in new adaptations o brickwork, and a high grade of brick manufacture, all of which will work for the good of the trade.

Every day our cities are giving more and more attention to the matter of building, while there is a constantly increasing demand for better buildings, safer buildings, more beautiful buildings; in short, for such buildings as shall reflect in their appearance the character of a substantial and refined people. And certainly no young man interested in the art of bricklaying should think for one moment that there is any possibility of a decline in this ancient trade. Civilization cannot endure without buildings and mankind will need not only more buildings, but also better buildings. This trade, like others, is what those practicing it make it. The future extension of the craft as well as its desirability must be determined by those who have chosen to follow it, and it is within the reach of each mechanic to gain such an appreciation of his trade as to make his life more interesting and his work more profitable both to himself and to the state in which he lives.

The Great War unfortunately has destroyed thousands and thousands of buildings in the different nations of Europe, and long will be the task, though beneficent in its results, of the rebuilding of those ancient cities. America must not be expected to replenish its skilled workmen in this particular trade by importing those who have learned the craft in Europe. Europe itself needs these artisans. In our own country there must arise a

new generation of mechanics to follow this most necessary and useful vocation, and any American youth who enters this ancient trade with a spirit worthy of its best traditions is to be congratulated on selecting for his life work one of the most essential, useful, and noble of crafts.

SUMMARY

1. Bricklaying is an art, and as old as civilization.

2. Building is a measure of civilization and is also an expression of civilization.

3. The tombs of Ancient Egypt and Babylonian cities were built of bricks.

4. Many historical monuments in America were built of bricks.

5. The tendency of modern building in America is towards more permanent construction in brick masonry.

6. America needs men skilled in the art of bricklaying and can no longer depend on Europe to supply the need. It must train for itself the new generation of mechanics.

QUESTIONS FOR STUDY AND DISCUSSION

1. In what way does building indicate the progress of civilization? What would you judge from the character of the building in your own community?

2. Why is building in America less artistic than that of Europe? Do you see signs of change?

3. How is brick construction becoming more extensive? Are the forests getting further from the cities? Are people getting more settled in America than they were a generation ago?

4. What is the population of the United States? Is it increasing? Is there any relation between a growing population and building?

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CHAPTER II

MATERIALS OF THE TRADE

THE bricklayer, as the word indicates, is the layer of bricks, the man who takes each brick and lays it in such a way that a building or a wall can be made. The first kind of material, therefore, with which a bricklayer has to deal is bricks.

Bricks are made of clay, lime, and sand, all of which are mixed together in proportions determined by the brickmaker. More technically speaking, the common constituents of bricks are silica, manganese, lime, soluble salts, iron, alumina, magnesia, and sulphur. The material is molded in the shape of bricks, placed in a kiln and burned until it becomes very hard. Bricks are made in this way so as to withstand the disintegration brought about by atmospheric changes and the extremes of heat and cold. This disintegration which building material undergoes is generally known as "weathering". It is the result of chemical and physical action brought about by heat, dampness, and frost, as explained in Chapter V. Bricks that are hard-burned weather better, and are ordinarily put on the outside of the wall. The less burned, or softer, bricks are used for inside work for what is called "backing up". However, if great strength is required hard bricks should be used throughout the wall, or a fracture (spoken of variously as a "break", "crack", or "split"), may occur and weaken the wall.

There are many varieties of bricks, some being due to differences in composition and formation; others to the likes and dislikes of people, and to the special uses to which they may be put. Some bricks are made for appearance, some for strength, some for cheapness, and others for some one of many special purposes. Our bricks are somewhat smaller than the European bricks and average about eight inches long, three and three-quarter inches to four inches wide, and two and one-quarter inches deep. Some special bricks may vary from this size, but generally all have the same proportions, *i.e.*, so that the width of two bricks plus a mortar joint will equal the length.

The manufacture of bricks in the United States has gone through wonderful developments, and this country can boast of some grades of bricks which, for weathering qualities, for enduring stress, and for beauty of appearance, are unexcelled in any part of the world. American brickmakers have made possible wonderful advancement in brick building through their great skill in making bricks in many varieties of color.

The manufacture of bricks is an industry which has essentially local limitations because of the kind of clay which is to be found in different places. Therefore, the mechanic will discover that by working in different parts of the country he will come in contact with different grades of bricks, and he should be careful to avoid drawing conclusions concerning the general character of bricks until he has had experience in using the various kinds made in different localities.

What are some of the varieties of bricks? They may be classed as follows:

a. Common bricks.
b. Face bricks.

c. Wire-cut bricks.
d. Pressed bricks.
e. Glazed bricks.
f. Purpose-made bricks.
g. Cement bricks.
h. Fire bricks.
i. Paving bricks.

Common bricks are those made out of ordinary clay and burned in the usual manner in a kiln. They are used in ordinary walls and buildings where there is no particular need for special effects in appearance. It should be remembered, however, that even common bricks may be laid so as to make a very neat and attractive wall.

Face bricks are used for the outside of the wall and where accurate measurements are necessary in bonding or fitting, because there is more uniformity in the size of facing bricks than in common bricks. The term "face brick" may be applied to any good brick used for the outside of a wall which is designed to be beautiful in workmanship and appearance.

Wire cut indicates a method by which bricks are made. The material for the bricks is forced through a box-like mold made according to the width and length of the bricks, and then strips are cut according to the depth of the brick by means of wire arranged in a frame. These bricks show wire marks on the beds, but they are dense and regular in form.

Pressed bricks are made by placing the clay suitably prepared in a mold and squeezing it under great pressure. They are usually smooth on all faces, and have sharp and regular edges, sometimes with a frog on one or both sides. They are very dense. These bricks are usually laid up with very fine joints, and in the past decade so

extreme was this tendency, that much impractical brick work was attempted with unfortunate results. This so-called "press bricklaying" is not so popular to-day. The modern tendency is to have good-sized joints in the brickwork, so that a brick may rest on a solid bed of mortar. Pressed bricks furnish a good sample of facing bricks.

Glazed bricks are uniform in size. They are made in a mold, but later treated so as to give a glazed surface. They are made in a variety of colors, but probably the most popular glazed bricks are white. They are used in places where sanitation and cleanliness are of first importance, such as the interior of hospitals, depots, municipal buildings, elevator shafts, lavatories, etc.

Purpose-made bricks, as the name suggests, are those made for special uses. Some purpose-made bricks are rough-faced bricks used in the formation of certain artistic patterns and designed expressly for such work as panels and fireplaces and other interior decorations. Still other varieties may be those made for corners, arches, cisterns, sewers, chimney stacks, and the like.

Cement bricks are similar to common bricks in size and use, but are the result of the mixture of Portland cement made into rather a dry mortar. Naturally they are pressed into the mold so that they may become properly shaped and solid, although not so solid as pressed bricks. They are not kiln-burned, but are subjected to the same action as cement mortar. In other words, they set hard through the chemical action due to the effect of the air upon the material.

Fire bricks are made from fire clay, a material which will stand a tremendous amount of heat, and which does not crack and break to pieces when exposed to fire. They are used for lining fireplaces, boilers, heaters, blast fur-

naces, engine fire boxes, and the other places where it is necessary to retain extreme degrees of heat. They are slightly larger in size than the common bricks and much heavier.

Paving bricks, or "rough hards", are those bricks used for paving streets and walks. For special effect they may be used in walls. They are very hard-burned, somewhat thicker than the wall bricks but not usually any longer. They are made in great variety, but the kind most used has a brownish red color. When used in walls they must be handled skillfully by the bricklayer, for, being heavy and somewhat vitrified (that is, hard-burned and impervious to water), they slip off the mortar bed very easily. It is hard to keep them in their proper places, and if hammered much they get out of plumb. Great care should be taken to lay hard, vitrified bricks correctly at first, and avoid getting them wet except in very hot weather. In rainy and damp, or cold, weather, and if possible at all other times, strong cement mortar should be used with paving bricks, so that the joints of mortar in the courses below will become hard enough not to be squeezed out by the weight of other courses built upon them. These same principles apply to other impervious bricks — usually pressed bricks.

Characteristics of good bricks. Good building bricks should be sound, free from cracks and flaws, also from stones, or lumps of any kind. Lumps of lime in bricks, although they may be small, are especially dangerous; they slack when the bricks are exposed to moisture, and split the bricks to pieces, and if plastered upon are certain to cause the plaster to "blow", or "blister".

For good brickwork the bricks must be regular in shape and uniform in size. The edges should be square, straight, and sharply defined. The surfaces should be

even, and not too smooth, so that the mortar can stick to them. Theoretically, good bricks should not absorb more than one-fifteenth of their weight of water. The average bricks, however, absorb about one-sixth of their weight. The highly vitrified bricks may take up as little as one-thirteenth or one-fifteenth.

Good bricks should be hard, and burned so that there is thorough vitrification all through the brick. Such bricks when struck against one another will give out a ringing sound. A dull sound indicates a soft or shaky brick.

While perhaps on the whole the bricks are a little smaller in size in America than in Europe, this is a distinct advantage to the American bricklayer because large bricks are inconvenient for the ordinary man to grasp, and accordingly sooner tire the bricklayer who must lift the brick when wet and lay it with one hand. Though most of the English bricks, for example, weigh about seven pounds, it is, perhaps, safe to assume that the American brick for ordinary brickwork averages in weight about five pounds.

In order to make good brickwork possible, the length of each brick should exceed twice its breadth by just the thickness of a mortar joint. A little experimenting by the reader himself with a few bricks laid up dry will easily demonstrate the importance of the above statement.

Hollow tile is a brick material used commercially where bricks were previously employed in partitions and for furring. Tile is made in varied units usually larger than bricks, and has the advantage of increase in bulk without a corresponding increase in weight. It is more damp-proof when used on the interior of the walls, and also less liable to convey sound and vibration. With hollow tile a bricklayer can lay up more wall in a given time and

use up less mortar. It can be plastered up readily, and if used in the proper place, in conformity with correct stress calculations (which are determined by the engineer), it does not interfere with the stability of the wall. This usually requires face brick on the outside, which is properly tied into the tiling by headers, either "visible" or "blind". However, for residence purposes and for certain classes of business building, the walls may be constructed entirely of hollow tile, plastered on the outside by specially prepared material generally known as "stucco". Of course, the bricklayer cannot be persuaded that a stucco finish is as desirable as brick, for in a comparatively short time and invariably in the course of a few years, stucco, being merely a surface of cement plaster, cracks because of the action of extreme temperature, and because of slight settling of the foundations. Hollow tile, however, is ordinarily cheaper to lay than bricks. To lay hollow tile involves the same principles as laying bricks, but is considered rough work. It is, however, almost everywhere considered bricklayer's work. Hollow tile is in the trade to stay and the enterprising bricklayer, wherever possible, will acquaint himself with this form of building material.

Fireproofing, or furring tile, is a term sometimes used to designate a certain type of hollow tile used on large buildings in floors and partitions for the purpose of fire prevention. Bricklayers perform this work (see Chapter V).

Cement blocks are made with varying proportions of Portland cement and sand, ranging from the proportion of one part of cement to two parts of sand, to one part of cement to five parts of sand. These are usually made hollow in shape through the use of a simple molding machine which presses the mixture tightly into the mold.

These blocks vary in size but are usually about eight inches in depth, and approximately two feet in length, sometimes less. In thickness some are made eight inches, and others twelve inches, and others are made to approximate the thickness of brick walls, two and three bricks thick.

Cement blocks are used for basements and for small and temporary store buildings, yard offices, etc., and sometimes for dwellings. They are cheap, and easy to lay up. For durability, however, they are not so desirable, for they seem to fracture easily; they are lacking in neatness in appearance, and impress one as dead in color and artificial. They nevertheless have their uses and have become a permanent factor in building in a small way. At any rate, it is a bricklayer's job to lay them, although it is not considered by him to be a very desirable job.

Terra cotta may be regarded as another substitute for bricks, although "terra cotta" as understood by the trade is brick material made up into parts for a wall according to a particular purpose or design. It requires a better quality of clay than bricks. Thus ornamentation for building fronts, for window sills, for window heads, lintels, arches, cornices, parapet walls, copings, moldings and belt courses, panels and pilasters, etc., may be accomplished through "terra cotta" made for the purpose. The word "terra cotta" means "earth cooked", or in other words, a kind of pottery. Terra cotta as a brick material ranges in color from white to a deep red, but the most prevalent shade in America is light yellow and cream colored with a glazed surface. Very often it is used to imitate Bedford limestone. Sometimes, however, terra cotta material is prepared in red so as to blend with red brickwork. Many of the skyscrapers have

their fronts finished with terra cotta, for it has the advantage of lightness and yet gives the appearance of great stability. However, terra cotta does not seem at the present time to be as popular as it was a few years past. Its chief disadvantage is its shell-like character, which requires careful filling in, and its inadaptability for good "tying-in". Many examples of terra cotta work can be seen where the terra cotta has split, and shelled from the main body of the wall. Of course, this may be due to bad workmanship, but the fact remains that terra cotta lends itself to poor workmanship inasmuch as the outside may look excellent, while poor quality may be possible in the interior. This fact is a challenge to the mechanic or the builder in charge to see that the work is properly performed.

Tiles. Since bricklayers are usually called upon to use tile, tile must be considered as bricklayers' material. Mention has already been made of fireproofing tiles, and they need not be considered in this connection. What we wish to speak of here, briefly, is the tile used for roofing, paving, decoration, and sanitation.

Tiles are made out of the same materials as bricks and in about the same way except that the quality of material must be better and purer, and the workmanship more carefully performed, especially for the tiles used for decorative purposes.

The *roofing tiles*, which are flat, pan shape, and corrugated, are not used as much in America as in Europe, because of the extensive use of patent roofing in the New World, and the use of shingles on residences. The decorative tiles, sometimes spoken of as "encaustic tiles", are very widely used in America. The color is mixed in with the clay and is made a permanent part in the process of burning. Tiles with patterns constitute a real work of

art, and decorative tile making is a highly specialized manufacture.

The common paving tiles range in size from six by six inches to twelve by twelve inches and about one inch thick. The roofing tiles are usually not more than one-half inch thick, as it is necessary to have them as light as possible. Decorative flooring tiles are usually about one inch square and approximately one-quarter inch thick. Flooring tile, however, is frequently made octagonal in shape. With tiles small in size it is possible to work out pleasing patterns. Tiles used for decoration on walls are usually from four inches to six inches square, although there are various sizes on the market. Wall tiles are usually white glazed, especially in restaurants, lavatories, and the like.

Mortar has a twofold purpose in construction; one is to act as a binder to hold the bricks together, the other to add effectiveness in appearance of the joints on the face of the wall, or to show up the bond. Usually mortar is made either of lime and sand, cement and sand, or a combination of sand, lime, and cement. Cement mortar is sometimes called composition mortar, or, as the trade frequently terms it, "compos". Lime and cement are the elements which give the setting qualities to the mortar, and the problem in determining the quality of mortar is to see that it will not set before it can be used in the joints, or before the bricks are laid in their permanent bed in the wall. The proper mixture of lime or cement with sand will give the mortar the proper consistency, so that it may be worked easily with the trowel. In modern buildings the mortar is usually made up of lime and sand with a little cement used to give it harder and quicker setting qualities and, in some cases, to enable it to be used more easily with the trowel. All mortar should

be thoroughly sound and well mixed, neither too stiff nor too plastic.

The properties of mortar depend quite largely upon the character of sand that is employed. If the sand is "sharp" and if it is clean and well screened, the mortar can be made very good. If the sand is fine, there is less give to the mortar, the water works out easily toward the edge of the mortar board when being used, and the mortar becomes solid and difficult to trowel. For the same reason mortar so made very often sets on the wall before the bricks can be put in their place, especially if the bricks are dry, or are absorbent. Where the bricks are soft and absorb moisture easily, cement mortar is very hard to use, and when this kind of mortar is used, the bricks should be well "wetted down".

Mortar should be made up in as large batches and as uniform in mixture as possible, great care being taken to maintain an even quality of good mortar throughout the job, for a good building may be completely spoiled in appearance and its stability impaired by the use of a variety of inferior grades of mortar. The building codes of the large cities of the United States call for lime mortar mixed in the proportion of three measures of sand to one of lime. Mortar made up hastily in small batches is quite likely to vary in quality and to prove unsatisfactory in use. It is better, usually, in preparing mortar to mix the dry materials first, that is, the lime or cement and sand, so that it all bears a uniform color, and to add the water later to bring it to the proper degree of "paste".

The time which a bricklayer uses in laying a given quantity of bricks is dependent in no small degree upon the quality of mortar. With good mortar the bricklayer can work much faster, can build a very much better wall, and is better satisfied with his work. Very frequently

bricklayers insist upon getting the right kind of mortar, and sometimes they start a disturbance because of the poor quality of the mortar. Every good mechanic takes pride in his work, but he cannot do the kind of work that should be done unless he has the material to use which will enable him to make a job good. Bricklaying at best requires considerable physical energy, and it is certainly a poor practice to make the work more strenuous because of poor mortar. The apprentice should spend a little time around mortar boxes while at work and watch the way mortar is mixed; and while it is not advisable for him to tell the other man what to do, he may be able to increase his information, by asking suitable questions.

Cement mortar, that is, mortar made of Portland cement and sand, is used for walls which require great strength. With this kind of cement hard bricks are generally used, because the advantages due to the use of a hard mortar, such as cement mortar, are entirely lost if the bricks of the wall are soft and unable to resist either the pressure of weight or the ravages of the elements. Cement mortar is nearly waterproof and will stand the extremes of temperature better than lime mortar, which is not waterproof. It is not usually as easy to make smooth face joints with cement mortar as it is with lime mortar, but if care is taken, a very neat-appearing wall can be built out of cement mortar. Cement mortar must be used as soon as mixed, because one of its distinctive features is rapidity of setting.

Lime mortar to have the "fatness" necessary to spread well should be made up at least two weeks before it is expected to be used. Usually the less new the lime mortar is the better the work. The mortar should be "tempered" (*i.e.*, made into the proper consistency of plaster) until all the white spots disappear, otherwise the spots will swell

and "blister" on the wall, breaking the initial set of the mortar after the bricks are laid.

Mortar mixing is a subject the bricklayer must watch. If more than the right amount of sand is put into the mortar than is necessary to enable the bricklayer to work to the best advantage, the bricklayer will drop a lot of the mortar off the trowel on the ground, because when there is an undue proportion of sand the mortar becomes "short", as it is called; in other words it fails to "hang". The extra time necessary to bed the brick and "throw up" the cross joints in such circumstances will make a cost more than equal to the value of the lime which might be saved. On the other hand, if there is not enough sand, the mortar is sticky, and consequently, it is harder for the bricklayer to maintain quick and free motions, and to keep his trowel clean. The two extremes must be avoided.

When cement is to be mixed with lime mortar it is better to mix the cement with dry sand before adding it to the lime mortar, and just before it is to be used.

After mortar has set, it should not be disturbed because the setting comes about by the interlocking of the crystals of the mortar. If these crystals are broken while forming, they will not properly reunite thereafter.

Mortar color is a material made by a chemical process and used in mortar to give a color that will either by likeness or contrast harmonize with the general appearance of the brick. It is a fast stain or dye which mixes readily and should form chemical union with the mortar. It should not fade, neither should it injure the setting qualities of the mortar. Some of the shades of mortar color are black, brown, seal, red, windsor amber, buff, salmon, fern green, colonial drab, French gray, and terra cotta.

The quantity of color that is necessary depends, of course, upon the shade desired, and usually samples of colored mortar are made on the job so that the owner of the building may have an opportunity to see the effects and pass judgment accordingly. Usually the more thorough the mixing, the less color is required. Mortar color should never be mixed with hot lime. The hot lime will bleach or fade out the color, giving a washed-out appearance to the job.

The success of mortar coloring depends greatly upon the method of mixture. Color made by different manufacturers requires different methods. Sometimes coloring is mixed in water before being put with the lime and sand. According to other methods the dry color powder is mixed into the dry mixture of lime and sand or cement, as the case may be, and stirred thoroughly until the whole substance has acquired a uniform or even color. It is generally supposed in the trade that the color of the dry mixture is approximately the same as that which will show when the colored mortar is dry in the wall after use. Manufacturers in supplying the coloring give directions as to its use, and for the best results these directions should be followed, because they are usually based upon considerable experience and no little expense in testing the material. Mortar color is very popular to-day. It gives a neat and finished appearance, and one may say with certainty that the use of mortar color has increased the use of brick in buildings.

In modern construction there are usually other tradesmen on the job with the bricklayer, and it is practically certain that if the bricklayer understands the material which he himself has to use, it will not be difficult for him to gather information from other mechanics about the material of other related trades.

SUMMARY

1. The chief materials a bricklayer uses are bricks, tile, fire-proofing, terra cotta, cement blocks, mortar, lime, sand, cement, and mortar coloring.

2. Bricks exposed to the weather and subject to great stress and strain should be hard burned.

3. Bricks are made in great varieties and for innumerable purposes.

4. Brickwork is made more effective and desirable because of the varieties of color which may be used in the mortar.

5. Terra cotta, tile, cement blocks, etc., are to-day used where formerly bricks were employed, but they require the skill of the brick-layer for laying.

QUESTIONS FOR STUDY AND DISCUSSION

1. What can be considered a "good brick"? Could a brick be good for one purpose and poor for another?

2. How many kinds of bricks do you know of through your own experience? What bricks are made in your locality? Which are preferred? Why?

3. What are the advantages and disadvantages of hollow tile as compared with brick and concrete construction?

4. What are the uses for terra cotta? Do you see any in use in the buildings of your community?

5. How does the coloring of mortar influence the use of brickwork in modern building? How should mortar color be mixed?

6. Discuss the relative advantages, and contrast press brickwork of buttered joints with brickwork of large joints.

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CHAPTER III

TOOLS AND APPARATUS

Tools. The first and most necessary tool of a bricklayer is the *trowel.* It is a triangular-shaped, flat, steel instrument with a convenient handle, as shown in the accompanying diagram. It is the most practical instrument devised for laying bricks, as proved by the experience of centuries. It is used to pick mortar off the mortar board in order to spread it on the wall, and to prepare the mortar to receive the bricks in the proper bed. Trowels differ in length and width according to the tastes of individual bricklayers. The shorter trowel is supposed to be the most economical from the standpoint of use of energy, because with a shorter and wider trowel it is possible to pick up a given amount of mortar without having so much leverage to control in the wrist. With a shorter trowel the load will be closer to the handle than that of a longer trowel with the same amount of mortar. A long trowel requires greater strength in the wrist, but this and other differences are not always noticed by the ordinary bricklayer and the use of either trowel becomes common practice with the man on the wall.

The *brick trowel* is the largest of the trowels used by a bricklayer. It is used for ordinary bricklaying. It approximates in size ten and one-half inches to twelve inches in length and from five inches to eight inches in width. The so-called *buttering trowel* is a modified brick

trowel, usually one that has been used a long time and worn or ground down to a convenient size. This trowel is used for getting good fat mortar on the back of the trowel, in order to butter face bricks, so as to get a very fine joint. Buttering is the process of spreading mortar on the brick to be laid. This method of spreading mortar was quite prevalent a few years ago, but is becoming less popular as time proceeds, as experience demonstrates bricks laid with an average bed of mortar give a more substantial wall than when buttered with a very fine joint.

The *pointing trowel* is similar in shape to the brick trowel but very much smaller in dimension, being three inches to six inches in length and two inches to three inches in width. It is designed for use in facing joints which have been raked out or weathered out. This pointing trowel is used for a number of different jobs and is convenient to use around buildings because a pointing trowel can be used in places where a brick trowel would be too large. Trowels between the size of small pointing trowels and brick trowels are also made. These are used for a variety of purposes, and may be used for some kinds of pointing around buildings.

The *brick hammer* is peculiar in its shape, having a head of a few inches on one end and a pick-shaped extension in the form of a cutter on the other, as shown by diagram 1. To split or break bricks in large pieces, the square head of the hammer is used. When it is necessary to cut down the rough face of a split brick, or to cut skewbacks, etc., the cutting end of the hammer is employed. As a rule, a bricklayer uses the cutting end of the hammer too much and the head not enough. A brick hammer is used also in the plumbing of a corner, for tapping bricks tightly in their bed, for trimming

rough edges of bricks, and for many other jobs where a bricklayer needs a hammer.

The *plumb rule* is the tool necessary to guide the bricklayer in building the wall plumb or level. The most trustworthy plumb rule is the one which employs the "bob"; it is usually a well-squared, plumb, and true board about four feet long, four or four and one-half inches wide, and one-half or three-quarters of an inch thick, with a hole something less than a foot from the bottom, in which swings a lead weight suspended from the top of the rule by a cord. When this cord, which suspends the weight, "lines up" perpendicularly with the center of the rule as the rule is placed against the wall, the bricklayer knows that the wall is perpendicular, or what he terms "plumb". At the present time plumb bobs are rarely used, although they should be very much used in order to check up from time to time on other modern spirit levels and plumb rules. The modern plumb rule or level is made of a more substantial piece of wood than that used with the plumb bob. It has two spirit levels inserted at right angles to the length of the rule, one toward the top and one toward the bottom. These levels are properly "trued" so as to show the air bubble on a center line at both top and bottom when the edge of the rule is exactly perpendicular. Consequently, if the brickwork fits the rule under such circumstances, the wall is plumb. This same rule, which contains another spirit level laid lengthwise in one of its edges, is used for leveling brick or for building corners and testing horizontal on walls. These levels are very useful instruments and have the advantage over the plumb bob in that they are not affected by the wind. They have the disadvantage, however, of getting "out of true" more easily and require constant checking and

adjusting. There are, however, some very excellent levels and plumb rules made to-day. The plumb rule with the bob is still largely used in Europe, for only the Americans have taken to the universal use of the spirit plumb.

A scutch is something like a pick which has two points similar to the point of a brick hammer, but somewhat fine in design, as shown on page 29. It is used exclusively for cutting bricks, skewbacks, fire bricks, etc. It is probably not used sufficiently, and, as a result, many bricklayers spoil bricks, as well as trowels, and incidentally do poor work. By trying to make a blunt brick hammer do the work which a scutch should do, similarly unfortunate results are likely to happen.

The *brick chisel*, sometimes called a "bolster", is a chisel with a broad drawn-out edge from three inches to four and one-half inches in width used to cut bricks in certain shapes so as to present a clean, straight line on the edge of the cut. The cutting edge of the tool is placed on the line where it is desired to cut the brick; it is then given a sharp blow with a hammer. Where a good, perfect line is required on a skewback, a brick chisel is the proper thing to use. Its construction can be observed by diagram on page 29.

To guide him in laying of bricks a bricklayer requires *lines* attached to pins, or two square nails, whose edges are not too sharp. These lines may also be attached to round spikes whose points have been flattened so as not to turn around in the mortar joint. The spike being round is not so likely to cut the line when the line is stretched tightly. There is no universal practice about the use of nails, pins, etc., to attach the lines, but it is a universally known fact that in order to get a true wall it is necessary to have the line swing from the top edge

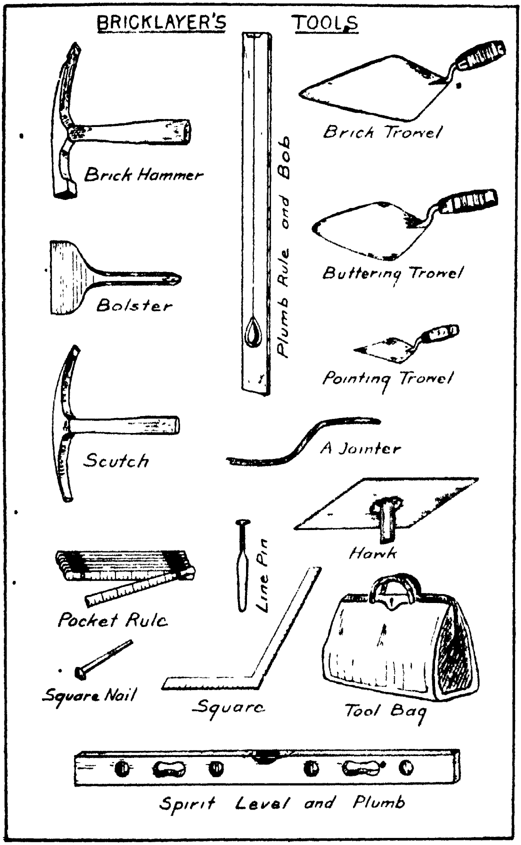

DIAGRAM 1. — The tools commonly used by the bricklayer.

of the corner brick. The line must not be attached to a pin in a joint three or four brick lengths away from the corner.

A good wall depends upon laying bricks properly horizontal so that the top edge of a row, or course of bricks, will line on the perfect horizontal. This cannot be done unless the bricklayer puts up the line on the corner very frequently, or unless his bricks on the corner have been laid with extreme care and each course properly leveled, tested, and squared.

Jointers are instruments used to give the desired effect on the joints between the bricks and to produce some of the effects shown on page 45. They are particularly necessary for making the tuck joint, the concave tool joint, V joint, and the square rake joint. Some examples are shown by diagram 7.

A bricklayer sometimes requires a *hawk* for pointing in brickwork, for filling putlog holes, etc. This is a board from twelve to eighteen inches square with a handle underneath. It is used to hold mortar for immediate use in case the bricklayer is working from a ladder or a scaffold or in some inconvenient situation where it is not easy to use mortar from a board on the floor of scaffold. Aluminum hawks are now manufactured and quite extensively used, especially by plasterers. These are durable and light, and prove to be very desirable for constant usage. Bricklayers do not often find it absolutely essential to have a first-class hawk, but frequently make one of wood on the job.

The *pocket rule* is an essential for practical work because a bricklayer is called upon very frequently to measure the distance between a given number of courses, so as to determine whether the mortar joints are being too tightly or too thickly laid. Moreover, he needs a rule to measure

to the top of the window or door frame, also to measure the size of a cut that he may have to make in a brick, and to make other measurements. A good rule for this purpose is a folding rule about four or five feet long. It is convenient and cheap. A rule longer than five feet is more easily broken. A folding two-foot rule, which is common among carpenters, is scarcely as serviceable to a bricklayer as a longer rule.

A *square* is an instrument which a bricklayer sometimes needs for corners and laying out walls. It is quite customary, however, for a bricklayer to borrow a square from a carpenter, or to make a temporary square out of wood which can be made quite adequate for his purpose.

A *tool bag* is necessary to contain tools and to carry them from place to place. This is usually a canvas bag which can readily be obtained for a reasonable price. Bricklayers' tools are heavy and not by any means delicate, and the tool chests required by the carpenters are not essential for a bricklayer.

It is scarcely necessary to add that the tools already described may be obtained in variety, so that a bricklayer may have the peculiarly adapted tool for the specific job he has to perform. If he has the tools enumerated above, he has a goodly supply to produce fair results in ordinary brickwork.

Apparatus. With every building go certain things which may not be properly classed as tools and yet are not legitimately in the class of materials used in building. In some trades they are often referred to as "shop tools". For our purposes they may be termed "apparatus". Among these would be the mortar boxes, mortar hoes, shovels, hods, elevators, and scaffolding.

A *mortar box* is usually about twelve feet long, six feet wide, and about one foot deep. Here lime, cement,

and sand, or any other material used, are mixed together with water so as to bring the right consistency.

Mortar hoes are used to mix and temper the mortar. They have usually two holes in the blade so that mortar can get through, and the material be more easily mixed.

The *shovel* is the well-known article necessary for putting the mortar into the wheelbarrows or into the hod, as the case may be, before it is moved to the scaffold.

The *mortar board* is the board which rests on the scaffold and contains the mortar for the man working on the wall to pick up with his trowel for direct use. These mortar boards are sometimes called "laying" boards; they are usually three or four feet square.

The *hod* is a hold for mortar made of boards joined to make a V with one end closed tightly and the other end open and rounded off. It has a handle about four feet long so that it can be lifted up and held under the shoulder by the building laborers. This is used for carrying mortar up ladders. It is being largely replaced now on most buildings by freight elevators used for hoisting brick, mortar, and other building material.

Wheelbarrows are frequently used for conveying mortar from the mortar box to the scaffold, and are particularly convenient to place on elevators which take them up to higher floor levels. The wheelbarrow also acts as a conveyance from the elevator to the wall or the bricklayers' work. The wheelbarrow has the obvious advantage of lessening the handling of the mortar.

Elevators are known to every one, although we are more familiar with those that carry passengers. The elevator used in the construction of buildings is a freight elevator of a temporary character. It is, as a rule, suspended by steel cables and operated by a steam engine.

Mortar mixer is a machine built on the same principles as the concrete mixer which can be seen nowadays in use in almost every building operation. It is driven by a small gas engine, and churns together the sand, lime,

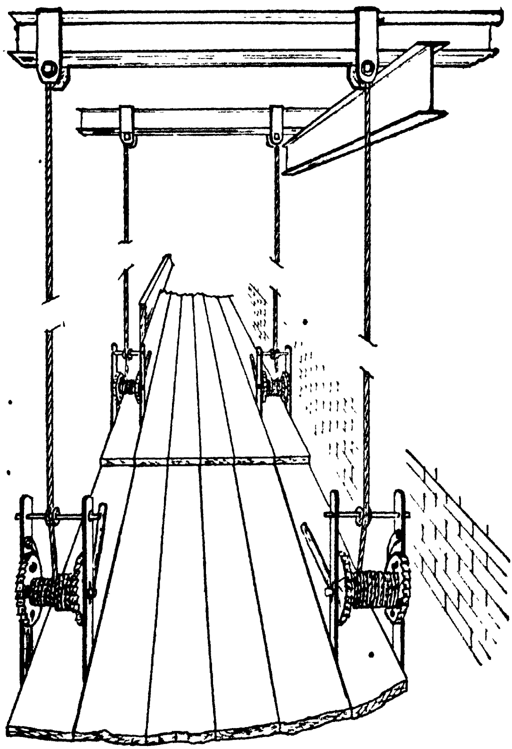

DIAGRAM 2. — Scaffold suspended on steel cables. Usually employed on skyscrapers.

cement, and water until the proper consistency of mixture is obtained.

Derrick crane is a piece of apparatus used for hoisting material by means of ropes or cables, and is generally operated by steam power. It is built upon a platform usually elevated above the construction operations so as to be high enough to make it possible to lift the material and put it in position easily.

Scaffolding is the staging required from which a bricklayer may continue to lay his wall after it gets beyond the height he can reach from the floor. There are varieties of scaffolding, for example, scaffolding upon

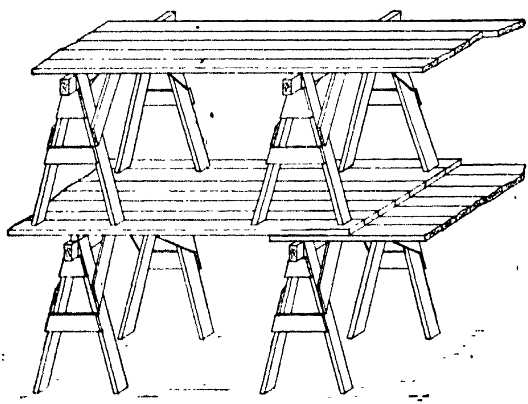

DIAGRAM 3 Builder's horse scaffold.

wooden horses, scaffolding suspended by steel cables, scaffolding supported by ordinary lumber, and scaffolding made from fir poles with putlogs running from the so-called runners into the walls. (See diagrams 2, 3, 4, and 5.) The fir-pole scaffold is the customary kind used in

Europe. In America where lumber has been very plentiful new lumber has been used for making scaffolds. "Six by sixes" and "two by fours" have been used as a base

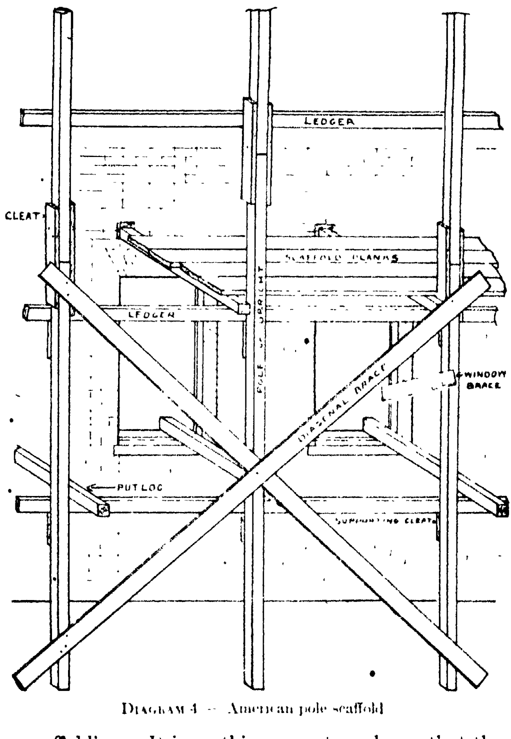

DIAGRAM 4 — American pole scaffold

for scaffolding. It is on this account, perhaps, that there have been correspondingly more accidents from scaffolding in America than in Europe. As time goes on, how-

ever, the American contractors have become more and more accustomed to practice the building of better scaffolding. The most significant thing when speaking about scaffolding in America, as compared with Europe,

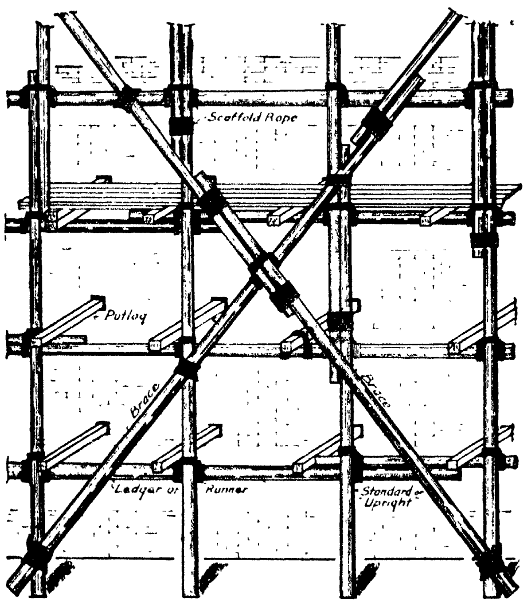

DIAGRAM 5. — European pole scaffold This type of scaffold is strong and can be used a long time without appreciable deterioration.

is the fact that in America bricklayers possibly do seventy-five per cent of their work "overhand", that is, they work from the inside and, therefore, can build their scaffolds from floors in the building. In Europe it has been customary to erect scaffolds on the outside. Clearly, it is

easier to build scaffolds on the inside of the wall than it would be to build them on the outside, therefore, the science of outside scaffolding has been somewhat neglected in America, although so far as skyscrapers are concerned the scaffolding used is second to none in the world for convenience and stability.

SUMMARY

1. In building construction there are two classes of tools, namely, hand tools and shop tools, or, as they may be termed, "apparatus".

2. The trowel is the principal tool of the bricklayer. The bricklayer uses ordinarily only two kinds — the brick trowel and the pointing trowel.

3. A good bricklayer should also have such special tools as jointers, scutch, brick chisel, brick hammer, a good plumb rule and level, and a pocket rule.

4. Among the shop tools or apparatus of a bricklayer are: the mortar box, mortar hoe, shovel, mortar board, hod, wheelbarrow, hoisting apparatus, and scaffolding.

QUESTIONS FOR STUDY AND DISCUSSION

1. What are the essential features of a good brick trowel? Discuss with some bricklayer of your acquaintance.

2. Compare the plumb rule with the lead bob and the spirit plumb rule, sometimes called only by the name of "level". What are the advantages and disadvantages of each?

3. Observe courses of brickwork on buildings that you know and notice whether the top edges of the bricks run in a level and straight line. Take into consideration what has been stated in this chapter with reference to stringing the line from the corner.

4. Compare the different kinds of scaffolding that you see. What proportion are built from the outside of the building, and what on the inside?

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CHAPTER IV

PRACTICAL BRICKLAYING

Preliminary considerations. In practical brickwork there are a few fundamental principles which apply to all brickwork, and which should be understood by every mechanic. They may appear simple, but they are none the less important. One of the first difficulties which a practical bricklayer has to encounter is the understanding of terms used in the trade. When one reads books on building construction one discovers that the terms used in books are entirely different from the expressions used by practical men in the trade. It is necessary, therefore, for the learner to take notice of the technical terms that are used in building, and to understand not only their meaning but also to find what other names are employed to designate the same thing or the same process. In all trades there is considerable difference between written terms and spoken terms. The practical bricklayer, for the most part, has to deal with spoken terms, but even these may differ in various localities. These technical terms are explained in a glossary on pages 163–7.

When a bricklayer goes on to a wall or building there are certain things which training and habit should lead him to perform without any particular conscious thought. The bricklayer should first take a keen glance at the scaffolding upon which he is to work to see that there is nothing broken or dangerous connected with it. He should accustom himself to do this until it becomes a

habit and the performance spontaneous. This is essential because more important than anything else to him is the preservation of his life and limb. Before a bricklayer starts to work he should examine his tools to see that they are fit for use; his trowel, his brick hammer, and pointing tools should be clean and ready for work, and his plumb rule should be tested so that all may be in the best condition for good workmanship. Of course, he should be properly clothed for the work, in the manner suggested in Chapter VII.

Spreading mortar. The first thing a bricklayer must really know is how to handle his trowel, and to pick mortar up with it. This he can do by practicing on the mortar board before working hours and during lunch periods, etc. He should learn to pick up a trowelful of mortar cleanly, and should learn to spread sufficient mortar to lay at least three bricks with one trowelful of mortar, and in the one series of motions necessary for a spreading operation. Later, by practice, he will become sufficiently skilled to take enough mortar on a trowel for a length of four or five bricks. To *spread mortar* properly is a great accomplishment and may mean the difference between a good mechanic and a poor mechanic. At any rate, it means the difference between a fast bricklayer and one who is slow. Practical men are always ready to give suggestions of how to use a trowel and that, added to experience through practice, will bring the desired result. Common brick mortar should be laid in a bed so as to give a joint from three-sixteenths to one-half inch in thickness. The usual calculation is eight courses of brick plus the bed joints to measure two feet in depth.

Pressed bricks, which are buttered, can be laid with a one-eighth-inch joint, although a joint of three-sixteenths

of an inch is to be preferred, as it more easily permits the proper filling of the joint.

When spreading mortar it is necessary to make sure the bricks have been sprinkled, for if too dry the mortar will become hard before the bricks are properly in place, and sometimes even before the mortar is properly spread.

Laying to the line. Adjusting the line is very important in building a straight wall. This must be done so that the face of the brickwork will be workmanlike. Bricks on the face of any wall are laid to a line. A fairly strong cord not thicker than $\frac{1}{32}$ inch should be employed and should be stretched as tightly as possible so as to prevent any sag in the middle. In case any stretch of line is so long that a sag cannot be avoided then the middle of the line should be held up by what is known as a *trig*. A trig may be one brick laid for the advance course or it may be several courses built up and plumbed so as to be a guide for the line in the center of the wall. Corners are erected first to give a place from which to *string* the line. These corners should be erected plumb and according to proper design, and, of course, if they are built properly and the line is strung from the corners the wall will be correspondingly correct, provided the bricklayer lays according to the line.

There is a great tendency for young, inexperienced bricklayers to do what is known as "crowd the line", that is, get the bricks to press too closely to the line. This causes the wall to show a bulging appearance. This is also called laying *strong* on the line. A skilled bricklayer working with other men lays the brick so as not to touch the line any more than is absolutely necessary because when one man disturbs the line, another bricklayer on the wall may find it difficult to lay the bricks properly.

Therefore, a mechanic's motion with the trowel should be so swift and so adept as to perform the spreading of the mortar without disturbing the line at all. This can be done with practice and care.

Working condition of mortar board. The young bricklayer should keep an eye on the condition of his mortar board, which should be kept clean on the outer edges, with the mortar turned up toward the middle. If the mortar is spread all over the board and chopped into with the trowel in a slovenly fashion, it will dry quickly and become hardened; and, consequently, it will be difficult for the bricklayer to pick up a clean trowelful, while at the same time the mortar will be difficult to spread. Usually the workmanship of the wall which a bricklayer builds has some relation to the condition of the mortar board which he uses.

Types of brick buildings. Modern brickwork may be classified under four main headings: first, *underground work*, which is a class distinct from other work; second, *brick residences*, which have become a distinguishing feature in American life and which also play a large part in the trade of bricklaying in European countries; third, *public buildings*, such as, city halls, state capitols, and buildings where beauty of architecture and durability and excellent workmanship are the criteria; fourth, *manufacturing and business buildings*, which probably form the bulk of the building trade activity in our country.

Essential to all buildings is the *foundation*. Until recent years practically all brick buildings had a brick foundation, but at the present time we find that brick foundations are being replaced by concrete. Concrete is easier to put in below the ground level. It forms a homogeneous mass, and can be made waterproof. The objections usually made to it on account of its dullness

in color and its lack of finish on the surface, etc., do not hold where concrete is used for underground work.

In a great many cases, when the bricklayer gets on the job the foundation has already been put in for him by a concrete man, but frequently the foundation is built of bricks. However, there is nothing mysterious about a foundation built with bricks. A brick wall should, of course, be built upon solid ground so that when the wall is erected there will be no settlement sufficient to produce a crack or split in the wall, technically called a "fracture". When a firm bottom has been obtained the bricklayer should see that the trench in which the wall is to rest is wide enough so that the first foundation course in the wall can approximate double the width of the finished wall, that is to say, if a wall is to be the width of two bricks, the first foundation course should be the width of at least four bricks. The first and second courses on the bottom should be the same width, the next course should be set in half the width of a brick on each side and

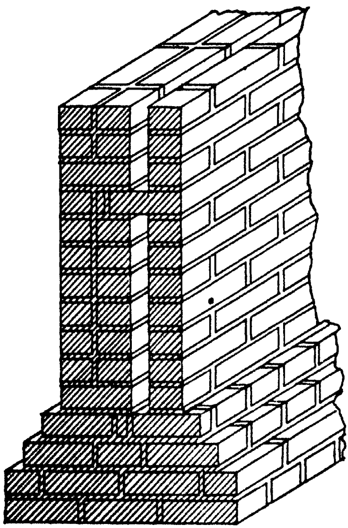


DIAGRAM 6.—Section of footing and cavity wall.

on each successive course until the desired thickness of the wall is reached. This will bring a balanced "footing", as it is called, and will produce what experience has shown to be a fair bearing surface. The example of a footing is shown in diagram 6. Where concrete footings are made the final thickness of the wall is begun and continued from the first course laid on the cement or concrete. The joints used in foundation work are usually either flush or trowel. Foundation work is usually required to be flushed solidly so that the utmost strength and durability can be had. In many cases a plastering of cement is put on the outside of the foundation wall by the bricklayer as the wall proceeds in height. This is designed to assist in keeping dampness from penetrating from the ground through the wall. Most foundation work is built deeply enough to make a basement possible.

Residences, particularly in our country, involve brickwork in many instances only as a supplementary material in order to add beauty in appearance and to make the structure more permanent. Frequently a wooden frame is constructed and brickwork is laid up on the outside. This is known as "brick veneer". But the brickwork may be built around cement while buildings may also be part frame construction and part brick construction. However, many homes are built entirely of brick, the walls usually being constructed so as to produce an air cavity which makes the wall dry in damp weather and cool in hot weather. Such walls are known as cavity walls. An example of this is shown in diagram 6. In cottage building great attention is given to appearance of the brickwork, that is, to the form of the bonds and to the character of the joints and to individual bricks. Where bricks are laid to veneer a frame structure the courses are tied in by galvanized ties which are nailed

to the boards of the frame and held between the courses of the bricks at regular intervals.

In *public buildings* brickwork is usually carried on along with stonework; that is, stonework may be used on the outside and brickwork may be used on the inside; in other cases, brickwork may be used in the body of the wall and stone trimmings employed to enhance the beauty and appearance of the building in such places as window sills, lintels, window heads, or window arches, archways, etc.

In *manufacturing buildings* the work is usually plain and substantial and quite generally supplementary to reënforced concrete frames or skeletons. Most of our manufacturing buildings to-day are made either of structural steel or reënforced concrete, around which the brickwork is built. Steel structures are perhaps used most frequently for office buildings, and reënforced concrete for manufacturing plants. Skyscrapers in our great cities which seemingly present a stupendous wall of masonry in reality receive their stability from the steel frame which is erected before the covering of brickwork is put in place. Brickwork in this instance is a casement used to make a substantial appearance.

Joints in brickwork. Jointing in brickwork is a term which signifies the character of facing which is given to the layer of mortar that is spread between bricks. This jointing has a manifold purpose. It is employed for waterproofing, that is, to make the joint hard and smooth, to make it difficult for the water to penetrate; also it is used for the purposes of ornamentation so as to bring about certain effects to the eye. Again, certain kinds of jointing may have preference over other kinds of jointing because of the relative speed which may be acquired in the construction, showing that convenience and speed have

some influence in the character of jointing. The joints most employed in modern brickwork are:

First, the *struck joint*, generally of two varieties, is shown in the accompanying diagram. This is made by a stroke with the edge of the trowel near its point, but while the joint is moist and fresh.

Second, the *weather joint*, designed to shed water easily from the wall, and, as the word indicates, to withstand to better advantage the ravages of stormy weather. On common brickwork it can be made by striking the joint downward with the top edge of the trowel.

Third, the *tooled joint*, a joint upon which the effect is produced by the use of a tool as shown in the accompanying diagram. Tool joints are made in several varieties: concave, convex, V joint, beading, and tuck pointed. (See diagram 7.)

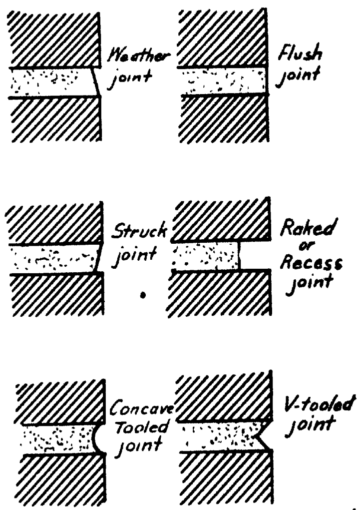


DIAGRAM 7.—Standard joints in brickwork, each one being best adapted for certain construction or effect.

Fourth, the *flush joint* in which the mortar has been cut off with the trowel and left without any further attention. Sometimes this is employed to give a rustic effect, at other times to save time and expense in places where

brickwork is not likely to be observed or where the character of the joint is not of particular significance.

Fifth, the *raked* or *recess joint* made by the raking out of the mortar on the face of the joint for a certain depth so as to show up the joints. This effect can also be produced by laying a strip of wood to fit the depth and thickness of the proposed recess upon the top edge of the course of bricks, these strips being removed when the brickwork is set. The raked or recess joint brings out in strong relief the units of brick, and enables the bond to stand out more prominently.

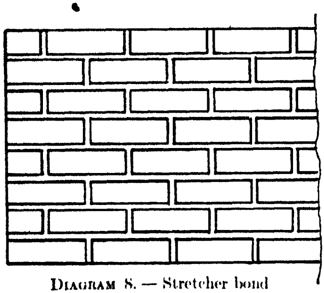


DIAGRAM 8. — Stretcher bond

Bonds in brickwork. *Bond* is a term used to denote the method of placing the bricks in the wall. It indicates the way in which vertical joints are arranged so as to make the courses of brick bind in one solid mass in the wall.

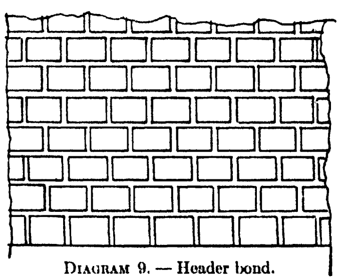


DIAGRAM 9. — Header bond.

Bond is made up of courses of bricks laid as "stretchers" or "headers". A *stretcher* is a brick laid lengthwise with the long edge to the face of the wall. A *header* is a brick laid in the wall with its end toward the face. If a course of bricks is laid lengthwise, we say that

It is a stretcher course, if endwise, it is designated as a header course. Courses which are all stretchers produce a *stretcher bond* and, likewise, courses all headers a *header bond*. (See diagrams 8-9.) It is the variation in

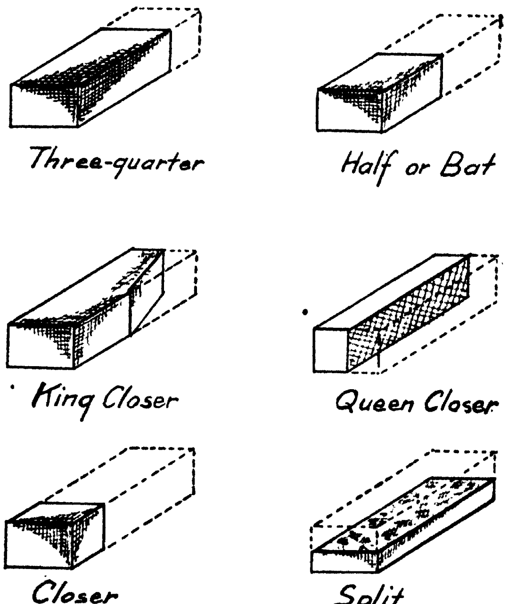


DIAGRAM 10. — Parts of brick used in construction of bonds and names of these various parts.

the number and position of stretchers and headers in the wall that give the different bonds. A bond is not the same thing as a pattern. A bond may be used to make a pattern but patterns are largely due to arrangement of

bricks varying in color, and shape, and texture. It is possible to use a variety of patterns and still not change the bond.

A *bat* is a broken brick described according to its size as a half, or a three-quarters. A quarter brick is often considered as a "closer". *Closers* are parts of a brick used to obtain the desired bond at the corner. They are of three kinds, the *quarter* closer, *queen* closer, and *king* closer. Queen closers are bricks cut in two from end to end, *i.e.*, a longitudinal cut. King closers are bricks cut so as to show at one end of the brick only half of the surface, while the other end is left whole, as shown in diagram 10. This closer is necessary in certain kinds of bonding. These *bats* and *closers* are just as essential in a wall as the whole bricks, although only a few of them are needed.

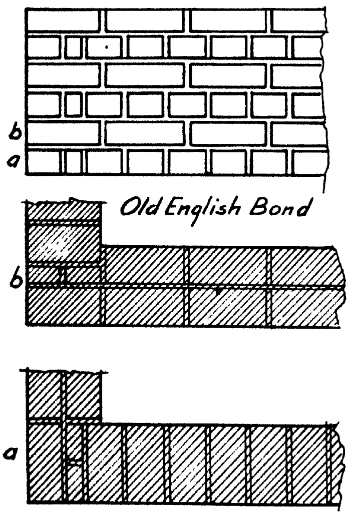


Diagram 11. — Note the alternate courses of headers and stretchers, and the closer next to the corner header.

Stretcher and header bonds are seldom mentioned when speaking of bonds. The reason is that they do not give a sufficiency of binding quality, for ordinary brickwork, except for the footings in the foundation. A wall of all

stretchers or all headers cannot be very strong in ordinary buildings. Stretchers and headers, however, form the basis upon which to build other bonds that are more generally recognized as proper modes of building brick-work. The two principal bonds are the *Old English* and *Flemish*. Most of the other bonds are variations of these two.

The *Old English bond* is made by alternating a continuous course of stretchers with a continuous course of headers, whose vertical joints appear precisely as shown in diagram 11. A closer is placed next to the corner brick on every heading course. Variations of the English bond are the English cross bond, English garden bond, and the Dutch bond.

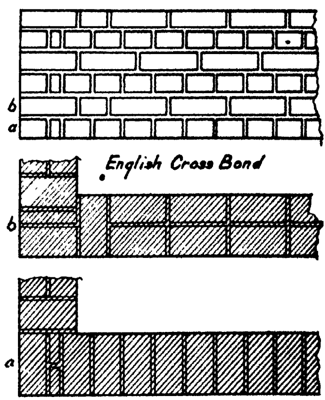


DIAGRAM 12.—Compare stretcher courses with those in diagram 11.

English cross bond differs from the Old English bond in the matter of starting the course at the corner; for every other stretching course has a header placed next to the corner stretcher, while the heading course receives no change. (See diagram 12.)

English garden bond is the kind used for building garden walls which are usually no more than one brick, or eight to nine inches, thick. Since the same header shows on two faces, and since they so often vary in length, the

fewer heads the more even the wall can be made to appear on each face. Consequently, one heading course to three or four stretching courses was introduced. It is

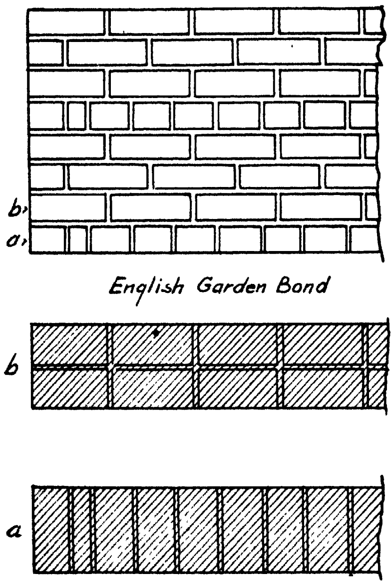


DIAGRAM 13. — English garden bond. Note that the header courses extend so that both ends of the headers are exposed to the face.

used, however, in many other places than in garden walls. This bond is also sometimes called *Scotch bond*, and in some localities *common bond*. (See diagram 13.)

Dutch bond, sometimes confused with English cross bond, is made by introducing a header as the second

brick in every alternate stretching course. The headers run right from the corners, omitting the closer found in Old English bond. This gives a better longitudinal tie, and causes the wall to have a better appearance on the face. (See diagram 14.)

The Flemish bond is made by alternating in the same course headers and stretchers, with vertical joints in

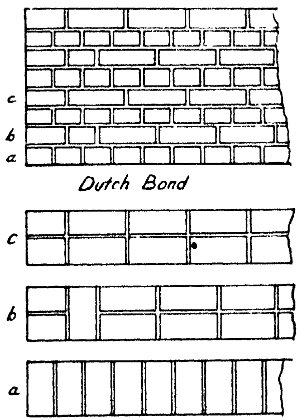


DIAGRAM 14. — Note the absence of closers and that all corner stretchers are three-quarters.

the exact position as shown in diagram 15. Its variations are the single Flemish, the double Flemish, and Flemish garden wall bond. Every header is immediately over the center of a stretcher in the course below it; closers are inserted in alternate courses next to the corner headers to give the lap.

Single Flemish bond consists of Flemish bond on one face of the wall, with English bond on the other. This is designed to get the advantage of what many consider

the superior appearance of Flemish bond on the face of the wall, but to get rid of its defects on the interior of the wall. This bond cannot be used except on a wall more than eight inches or two bricks thick.

Double Flemish bond is that which gives the Flemish bond on both sides of the wall. Sometimes this is done by " blind " headers on one side.

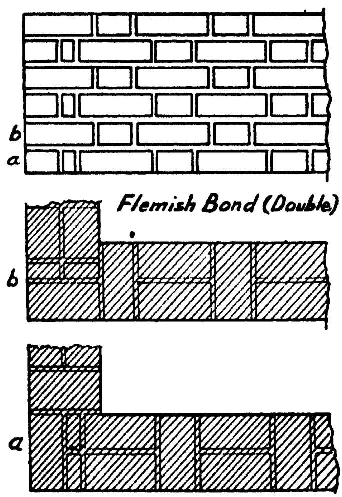
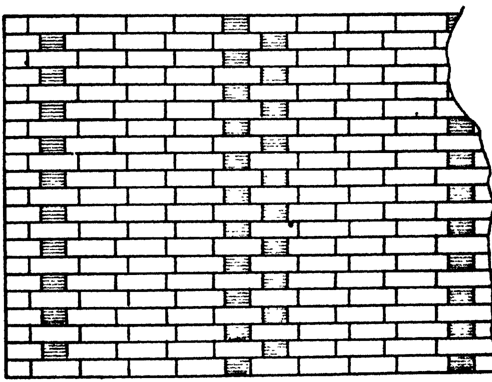


DIAGRAM 15. — Note the use of closers in alternate courses.

Flemish garden bond contains in each course one header to three or four stretchers. This bond has an advantage in appearance over the English garden bond inasmuch as the headers are more infrequent, making the evenness of an eight or nine inch wall greater than is possible with the English bond. (See diagram 16.)

Common American bond consists of one course of headers to every five or seven of stretchers. This bond is extensively used in this country. It employs fewer headers than the common brickwork of Europe. For example, in England common bond usually consists of one header for every three or four stretchers, although frequently five stretchers are used between the headers. Rarely,



Flemish Garden Bond

DIAGRAM 16. — Compare with diagram 15. Note absence of closers and more infrequent headers.

however, are seven courses of stretchers employed between the headers. American engineers have determined that a course of headers for every six or seven of stretchers is sufficient to give the wall the proper binding quality. It is contended that too many headers weaken the wall, inasmuch as headers afford only the minimum lap over the vertical joints above and below, and therefore allow the wall to break more easily when subject to uneven stress.

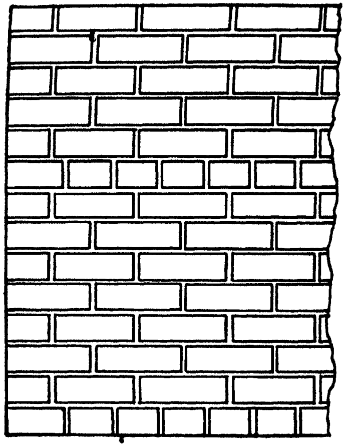


DIAGRAM 17. — The most commonly used bond for ordinary brickwork.

Notice the crack in diagram 18. This condition could not so easily happen were more stretcher courses employed, as, for instance, in the wall shown in diagram 17.

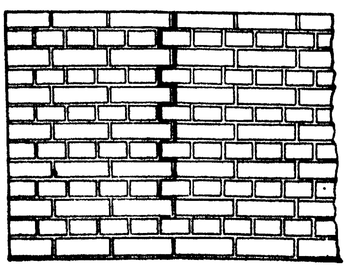


DIAGRAM 18. — Example of crack in wall. The effects of settling of a wall, in bonds such as Old English and Flemish.

Header courses take more time to lay, and if more of them are used than is necessary to give the proper qualities to the wall, considerable expense is added to the cost of construction. In ornamental work, however, these considerations are naturally secondary.

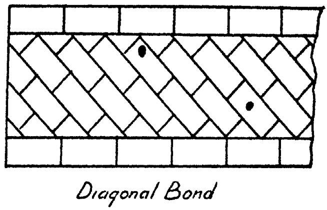


DIAGRAM 19. — Shows bond used in wide walls before concrete became so common. Still used occasionally. Good for paving purposes.

Raking bond refers to the placing of brick on the interior of a thick wall at a direction oblique to the face. This is done to insure a proper bonding of the interior joints of the course above and below. There are two kinds of raking bond; namely, the *diagonal bond,* and the *herring-bone bond,* both of which are shown in accompanying diagrams. The bonds are more frequently used, however, for laying causeways, sidewalks, floors, etc. (See diagrams 19, 20.)

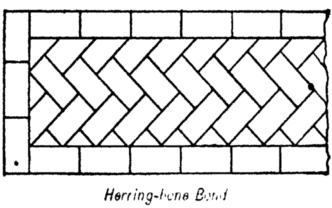


DIAGRAM 20. — Shows another method of laying bricks for same purposes as that shown in diagram 19. Herring-bone bond is more popular for paving purposes than the diagonal.

Other methods of laying bricks in a wall may be indicated by several trade terms as suggested below. A *rowlock* refers to a course of bricks laid on their edge in

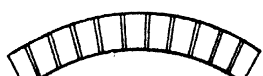


DIAGRAM 21. — Rowlock.

an arch so as to show at the face only the ends. Bricks laid the same way on a straight wall are called rowlock in some communities. (See diagram 21.)

A *soldier course* is that where the bricks are bedded so as to stand on end with face showing. To the early builders they no doubt suggested a line of soldiers, because of the straight standing appearance that they give. (See diagram 22.)

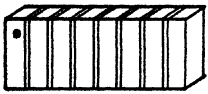


DIAGRAM 22. — Soldier course.

Bull-header is a term used to indicate a brick laid on its edge that shows only the end on the face of the wall. (See diagram 23.) A *bull-stretcher* is a brick laid on edge so as to show on the face only the broad side of the brick. (See diagram 24.)

Panel designs are frequent in modern building, especially where concrete or steel forms the more substantial element of the structure. They are presumed to give effect to the appearance of the wall, and to add beauty. These panels are infinite in variety, as the reader can well imagine. An example of a panel is shown in diagram 25.

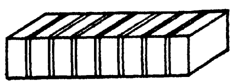


DIAGRAM 23. — Rowlock bull-headers.

Points of workmanship in keeping bond in brickwork must be observed. The vertical joints should correspond in alternate courses. This is known as "keeping the perpends". If this is not done it may be necessary to put a bat in the middle of the wall, and that spoils the bond and also the appearance of the wall.

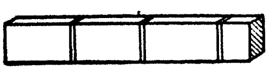


DIAGRAM 24. — Bull-stretcher.

For walls that are two or four bricks thick, it is a good rule to make the joints the same on the inside as on the outside for the common bonds. Three-quarters are

customarily used in America to bring the bond at the corner, rather than the closer. It is believed that the appearance of the wall is better with the closer eliminated.

Common arches. An arch is constructed to support the wall above an opening, such as a door or a window. It supports itself by an arrangement of the blocks or bricks, so that there is equal pressure on all the bricks. Every brick in the arch acts as a wedge. If the opening is narrow, the arch can be correspondingly small and may require little depth, as, for instance, one or two rowlock rings of brick on edge will be sufficient for an opening of about three feet or less. But when greater distances are to be covered it is necessary to have an arch whose thickness corresponds to the width of the opening. Arches are designed according to the load to be carried. This detail is usually determined by architects, but a bricklayer should at least know that such an arch is intended to support considerable weight and therefore should be performed in a workmanlike manner.

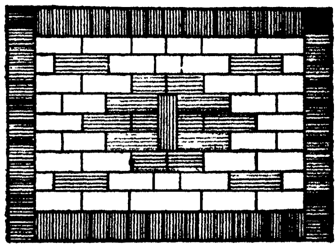


DIAGRAM 25. — Striking panel effects are obtained when two and three colors of bricks are used. Differences of texture are considered in some panel work.

Every arch has parts known in the trade by certain technical terms, or at any rate by terms which are likely to find their way on to blue prints because of their use by architects and engineers. These are given below.

Abutments are the parts of wall supporting the arch, and from which the arch springs. They pertain usually to

the support at each end of a series of arches, and not the intervening piers.

Piers are parts of wall supporting arches, and from two or more sides of which arches spring.

Skewbacks are the upper surfaces of the abutments or piers from which an arch springs.

Intrados, or *soffit*, is the under surface of the arch.

Extrados is the outer or upper surface of the arch, sometimes called the *back*.

Crown is the highest point of the arch.

Springers are the end or lowest bricks in the arch.

Voussoirs are the bricks or stones which make up the arch.

Key — the uppermost, central, and what should be the last laid brick or voussoir in the arch.

Springing points — the points from which the under curves of the arch commence.

Span — horizontal distance between the springing points.

Rise — the vertical distance between the highest point of the *intrados* from the level of the springing points.

Haunch is the name applied to the middle part of each side of the arch, *i.e.*, midway between the skewback and the crown.

Jambs are the sides of piers or abutments.

Spandrel is the term applied to the spaces between the level of the crown and the extrados of the arch.

For all curved arches, "centerpieces" of wood are used to support the brickwork until the arch is completed and the mortar set. The universal rule in constructing an arch is to start at the "skewback", which is the slope at the two ends of the arch upon which brickwork in the arch is supported, as indicated in diagram 26. Work should then proceed toward the center, the middle brick or key brick being the last to be placed in position. In

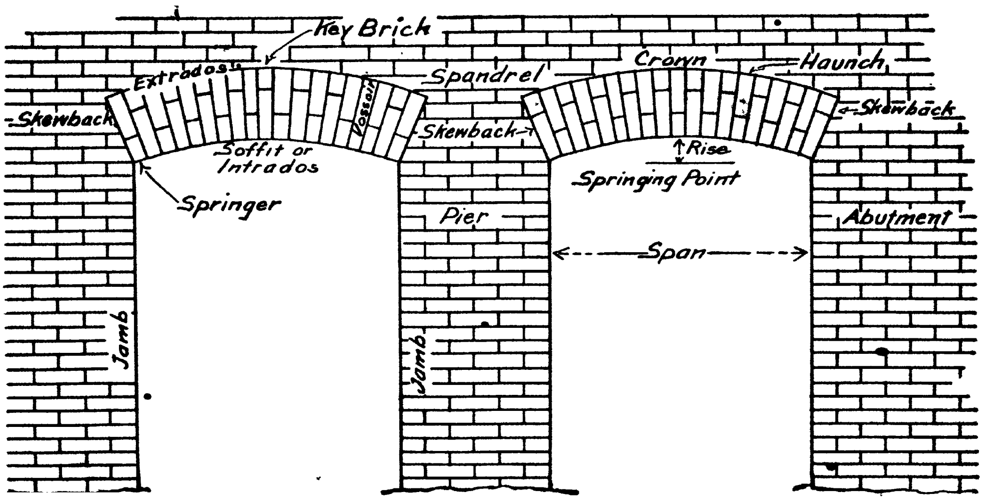


DIAGRAM 26. — Arches showing parts of arch construction with their technical names.

all arches the thickness of the mortar between the bricks should be uniform throughout if possible, and care should be taken before the center is reached to see that the bricks fit properly. In other words, the bricklayer should measure in advance to discover how many bricks are necessary to turn the arch. If he does this he can usually adjust the joints so as to make the bricks come even and not find it necessary to cut or split the key brick.

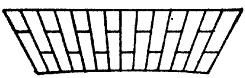


DIAGRAM 27.—Gauged jack arch. Bricks are cut to show lines running to a center.

The common arches in America are the *flat* or *jack arch*, and the *segmental arch.* The jack arch is shown in diagram 27. It is very popular in some sections of the country. The segmental arch is also very much used, and, like the jack arch, may be made by the use of bricks, especially cut, or by ordinary bricks adapted to the purpose by the arrangement of mortar in the joints. Where bricks are especially cut, the mortar joint can be made uniform throughout the arch, but where full-sized and uncut bricks are used, the top part of the arch, known as the extrados, has thicker joints than those in the bottom or what is called the intrados of the arch. (See diagram 28.) On the inside of the wall, backing the face of the arch, a wood lintel is usually laid across the opening, and upon that is built what is known as a brick core so curved as to form a base and upon this base is laid what is known as the *relieving arch*, sometimes called the *discharging arch.* This arch should carry the bulk of the weight of the wall and should be very substantially built. An example of what is described is shown in diagram 29.

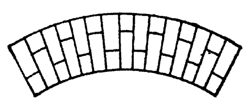


DIAGRAM 28. — Gauged segmental arch. Lines radiate to a center as shown in diagram 27.

Jack arches and segmental arches are "bonded", that is, the joints overlap as indicated in the diagrams.

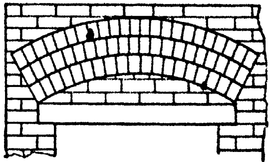


DIAGRAM 29. — Relieving arch. This arch permits a wood lintel at the top of the opening, but throws the weight above on to the piers at the side.

A very well-recognized arch is the *Roman arch*, which is a semicircular one. It is perhaps the strongest arch for general purposes that can be constructed. It is usually built of successive rings of bricks on their edge. (See diagram 30.)

The *Dutch arch*, as indicated in diagram 31, is an arch which is quickly constructed, and is frequently used over surfaces which are to be plastered. Its construction, however, is considered relatively weak.

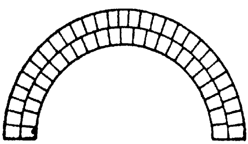


DIAGRAM 30. — Roman or semicircular arch. A type of arch that has been successfully used for centuries.

Inverted arches are those used in foundations, which are, as the word "inverted" indicates, turned under; in other words, they are the ordinary arch turned upside down. Inverted arches are used in places where there is danger of settlement and it is essential that the load of the building should be evenly distributed. When buildings contain numerous columns, it will be found not infrequently that the foundation contains these inverted arches from pier to pier, or column to column, to keep the piers and columns in their position and to make the distribution of the load (as the weight of the building is spoken of) even. (Diagram 32.)

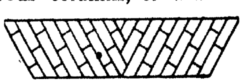


DIAGRAM 31. — Dutch arch.

The *elliptic arch* gives a suggestion of a combination of both the elements of the Roman arch and the segmental arch, and when properly constructed is considered to be a very beautiful design, while having elements of great strength. (See diagram 33.)

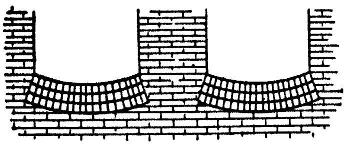


DIAGRAM 32. — Inverted arches. Used in foundation construction. Not often used now because of the increased use of concrete construction.

The *pointed arches*, which are commonly called *Gothic*, are extensively used. They are especially popular in church architecture, and in other large buildings where strength and beauty of architecture are desired features. (See diagram 34.)

A general rule for the right kind of arch is that when the load comes at the crown it is best to use the pointed arches, known as the Gothic. If the loads are symmetrically concentrated at corresponding points, that is, if the load comes on both sides of arch, as, for example, where a

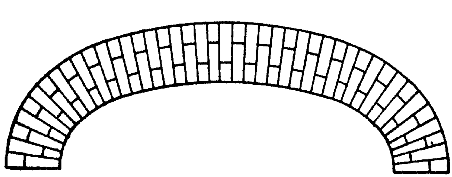


DIAGRAM 33. — Elliptical arch. Combines strength and beauty. Good for large openings.

girder or a column runs over each side of the arch, the elliptical or segmental form is to be chosen. Where loads are uniformly distributed over the arch, the best form is the semicircular or segmental arch.

Many substitutes for arches have been designed. In

dwellings and public buildings angle irons made of structural steel are often used in the walls above the opening, the bricks being laid horizontally on the angle iron. This eliminates all appearance of an arch, as well as the arch itself. The load is accordingly carried upon the angle iron or steel girder, as the case may be. This arrangement has a certain practical utility since an angle iron is ordinarily sufficient to support the brickwork above the opening, and it thus saves the expense involved in putting in an arch. However, it does not present a pleasing effect to the eye, for it gives a box-like appearance to the building; and one gets the impression that the bricks are going to fall out of place.

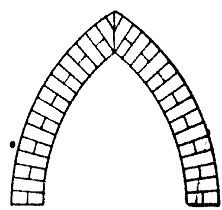


DIAGRAM 34. — Gothic arch. A popular arch for church edifices and public buildings of imposing architecture.

Stone and terra cotta are often used in smaller openings as substitutes for arches. Cement and concrete lintels are also substitutes for brickwork in many cases. In large openings, however, the use of the arch principles must be adhered to unless strong girders are employed. It is safe to say that the arch is coming into more common use in this country to-day. In engineering it can be noticed that the old flat steel bridges are giving place to concrete constructions involving spans bridged by arches. As the nation requires more and more substantial buildings, arches will continue to be more extensively used.

Arches have three classifications in respect to workmanship, namely, *gauged*, *rough axed* or *cut*, and *plain brick*.

The *gauged* arch is one with the blocks or voussoirs especially made or cut out for the purpose. A definitely known number of bricks go into the arch, each cut or

made to shape and each in its proper place. The mortar joints are made also according to definite measure, and must be uniform in thickness.

The *rough axed* arch is one in which the bricks are roughly cut by an ax, trowel, or scutch, and sometimes by the cutting end of the brick hammer. The *Dutch arch* is a good example. This type of arch is usually composed of those that are plastered over, for here appearance is not regarded as a matter of importance.

The *plain brick* arches are constructed of ordinary bricks without any cutting or gauging. These are perhaps the most numerous for ordinary openings in shop and factory buildings, as they are the most economical and generally serviceable.

To be workmanlike arches must be "laid out", or centered, before they are constructed. The *centerpiece* or *camber* which forms the temporary base and guide for the lower line or soffit of the arch is usually furnished by the carpenter on the building job. The carpenter receives his instructions from the foreman or superintendent, unless he takes the reading directly from the *blue print.* This centering or laying out of an arch can be done to scale on paper, or on a building it can be done to full size on the flooring or some other flat surface where it is possible to make visible lines. On paper it is necessary to have at least a ruler and a pair of compasses, but for full size a piece of string attached to a nail with a pencil tied on it at the proper length will act as a pair of compasses.

In order to proceed with centering one must have a knowledge of the style and the main dimensions of the arch; for example (*a*) the width of the opening, (*b*) the "rise" of the arch, *i.e.*, the distance from the level of the line from the bottom edge of the skewback (the springing point) to the central point in the soffit at the bottom of

the crown. This means that three points of the arch are determined, namely, the two springing points and the center line. If the arch is semicircular or Roman, half the width of the opening equals the rise, and consequently

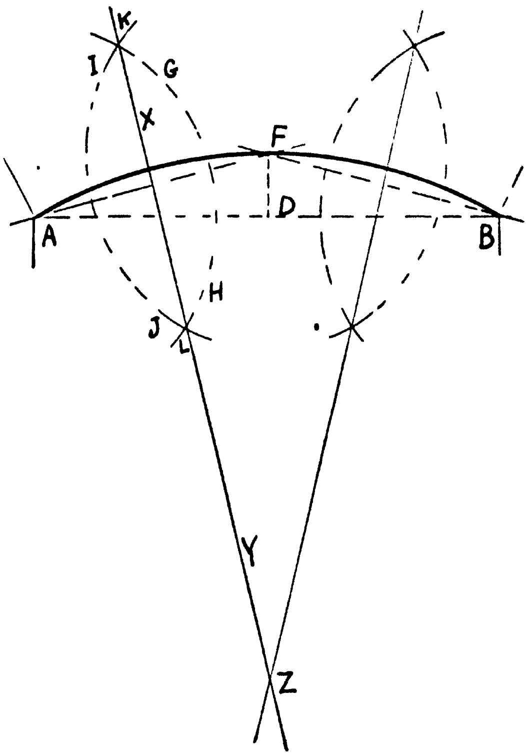


DIAGRAM 35. — Method of finding center for arch with the aid of the compass.

gives the radius to describe the segment of the arch, as shown in diagram 30.

These three points on the whole segment produce two smaller segments, one on each side of the center line. If the two arcs or small segments are bisected, and the bisecting lines extended they will cross at the center. The point of the compass on this center with the pencil located at the springing point will, when a line is drawn, give the curve of the arch. (See diagram 35.) A line or a segment may be bisected, *i.e.*, cut in two parts, by a simple process with compasses. The point of the compass is placed in position at one end of the line, and an arc is described, the radius of which must be more than half of the distance of the line to be bisected. The next step is to reverse the operation by describing an arc exactly like the first with precisely the same radius, with the point of the compass on the other end of the line. The two arcs will intersect or cross each other. Through the two points where they cross a line should be drawn, and it is this line that will exactly divide the line or segment in two parts.

Example,

Given width of opening, 4 feet.
Rise of arch, 6 inches.
Find center of arch.
Let line *AB* represent opening.
Let line *DEF* represent rise of arch.

The problem now is to bisect the distances between points *AF* and *FB*. Therefore, with point of compass at *A* with a radius anything greater than half the distance we describe an arc *GH*. Similarly, with the point of compass at *F*, with the same radius we describe another arc *IJ*. These two arcs intersect at points *K* and *L*.

A line now drawn from point K to point L will give the bisecting line XY. If this process is repeated on the other side, the bisecting line XY extended to meet the corresponding bisecting line on the other side will cross it at the point which is the center for the arch. This point we will designate Z. Therefore, with the point of the compass at Z, the curve of the arch can be made by passing the pencil through AFB.

All arches are made up of segments, except the straight or jack arches, but the centers for these arcs or segments

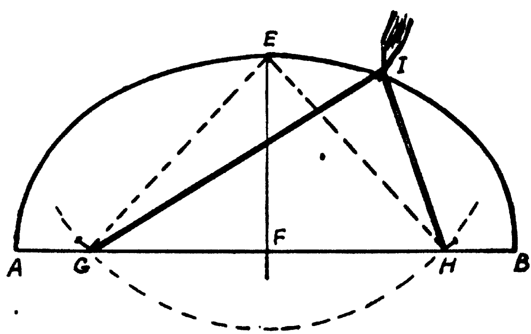


DIAGRAM 36. — Method of striking an elliptical arch. See description in text.

can be obtained by the process described above. This means that in an arch with more than one curve there will be more than one center point.

A good method of striking an elliptical arch is shown in diagram 36. For example:

Given length AB and height FE. Draw center line EF to establish point E. With radius the distance of AF (one-half the length of AB) from the point E, describe an arc intersecting line AB at points GH. Place pins at

points G and H, and attach a piece of string or thread equal in length to distance AB. When taut, the center of a string will reach point E. A pencil pushed along on the inside of the string will complete the ellipse.

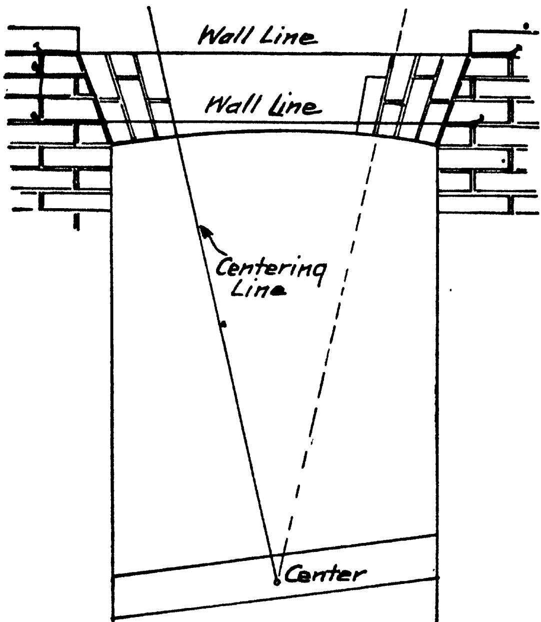


DIAGRAM 37. — Shows method of using lines in building an arch.

A bricklayer needs the center of the arch so that he can line up his skewback and maintain the proper line with each voussoir or block in the arch. In actual operation when the center point is obtained, particularly for face work, a board is fastened across the opening on which the

center point is marked. On the board at the center point a nail is driven in, and a line attached. The bricklayer on the wall uses this line, which he holds taut, to guide him in lining up the arch so that each voussoir radiates to the center point. He usually employs also two additional short lines, one toward the bottom and the other toward the top of the face of the arch, as shown in diagram 37.

Wherever the centerpiece is furnished to the bricklayer, he must first prepare the skewback to receive the arch. The usual practice is to stand a brick on its end at right angles to the centerpiece and then cut the skewback accordingly, particularly in a segmental arch, as shown in diagram 38.

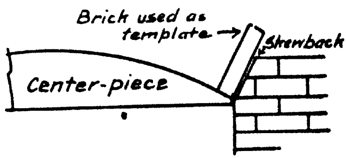


DIAGRAM 38 — Showing a practical method of determining slant skewback.

Jack arches usually require a template to guide the bricklayer in cutting the skewback. This is furnished by the foreman or superintendent on the job.

In the construction of all arches great care should be exercised to see that a definite number of whole bricks will go into the arch. Sometimes mechanics after working on the arch from both sides find as they draw in toward the center that whole bricks will not fit in evenly, and it is necessary to split the last brick or voussoir. This indicates very bad workmanship, and it is a disgrace to any bricklayer.

Another point to be observed is that the bricks in the arch receive a uniform bed both at the back and front. Sometimes careful attention to the joint on the face is accompanied by a neglect of the joint at the rear, and, as

a consequence, bricklayers find that their arch, much to their astonishment, bulges at the face.

In bedding bricks in an arch it is better to butter them. Great care should be exercised to give a solid and flush bed.

A successful brick arch cannot be made unless the bricks have been sprinkled before used. Unless the brick is damp it is impossible for the mortar to stick properly to the bricks. Each brick should be properly placed and secured in position while the mortar is plastic. If the brick is disturbed from its bed as the mortar is in the process of setting, it can never have as strong a place in the arch as if undisturbed.

If the mechanic is wise he will, in addition to what has been suggested concerning the use of lines, use a straightedge. This should be laid across the face of the arch from time to time as a guarantee that the arch is not "crowding the line", which would indicate a bulging outward.

The centerpiece of a jack arch should never be exactly straight, but should have a slight rise, not less than one quarter of an inch. This allows for a slight settlement. Jack arches laid with the soffit exactly straight appear to sag slightly after settlement, causing a very unworkmanlike appearance.

Needless to say that so far as lies in his power the bricklayer should see that his mortar is well tempered, and the bricks to be used as good and square as can be obtained.

SUMMARY

1. The bricklayer who would work on a wall should, to begin with, have habits of carefulness on scaffolds, good tools, ability to spread mortar, to adjust the line, and should keep the mortar and mortar board in good condition.

2. There are four classes of building, namely, underground work, residences, public buildings, and manufacturing and commercial buildings.

3. The principal joints in brickwork are struck, weather, tooled, flush, and raked. Joints struck with the brick trowel are most common.

4. The principal bonds of brickwork are Old English, Flemish, English garden, Dutch, Flemish garden, raking, and common American bond.

5. Common arches are jack or flat, segmental, Dutch, inverted, elliptical, and pointed or Gothic. They may be classified according to quality of workmanship as (1) gauged, (2) rough cut, (3) plain brick.

6. Arches can be centered by bisecting two divisions or arcs in the segment and extending the bisecting line until they intersect. However, the style of the arch must be known, also the rise and the width between the two springing points.

QUESTIONS FOR STUDY AND DISCUSSION

1. What is Flemish bond, and what are its merits? Its disadvantages? Old English bond?

2. How many different kinds of arches do you see in your community? On what kind of buildings do you see jack arches? Segmental? Gothic? Roman?

3. Take opportunity to watch practical bricklayers use the trowel, and by study and practice determine the least number of motions, and the least exertion necessary to properly spread a brick trowel full of mortar.

4. Name types of buildings that you know that will give examples of the four classes of building spoken of in this chapter.

5. Study from observation the relative merits of brick laid with "spread joints" and those laid with "buttered joints".

6. What advantage does the Dutch cross bond have which makes some people think it superior to Old English or Flemish?

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CHAPTER V

SPECIAL PHASES OF BRICKWORK

In every trade there are certain phases of the work which are considered special performances. The bricklaying trade is no exception to the rule. Therefore, we shall consider in this chapter some of the special kinds of work that a mechanic in bricklaying is supposed to do; such as the building of fireplaces, raising of corners, building of window and door jambs, setting of window sills, toothing and racking, corbeling, and fireproofing. We shall also include in this chapter a list of practical suggestions for general brickwork.

The fireplace. The open fireplace is perhaps civilization's most hallowed rendezvous. It has an irresistible charm which makes a universal appeal. Its cheerfulness, its warmth, its comfort and hospitable atmosphere make it the choicest social center. The open fireplace has furnished a favorite haunt for philosophers and dreamers through many centuries, and perhaps next to nature's out of doors has furnished the most fertile ground for the development of some of the noblest aspirations of mankind. There is little wonder, then, in a day of steam and hot water heated houses and apartments, that there is to be noticed a restlessness among the dwellers and a longing for fireplaces.

Unfortunately, however, few mechanics know how to build a fireplace and flue so as to avoid a so-called "smoky

chimney"; and yet the principles for correct construction are simple and easily applied.

Since a good fireplace depends as much upon the design as upon the workmanship, we shall consider the essential elements of both in this connection. Let it be said here, incidentally, that although expert mechanics may be able to build a successful fireplace without a working drawing, nevertheless, the rule should be always to have one. (See diagram 39.)

Some features of design in a fireplace are closely related to the matters of workmanship, and depend for their success upon good execution. The size of the fireplace is largely determined by the size of the room, the position of the fireplace in the room, and the individual tastes of the owner. A fireplace should be built of a size proportioned to the room, both with reference to height and breadth. The degree of projection into the room must also be considered. Some people prefer a fireplace projected into the room and others desire it to be flush with the wall, but such matters of proportion should be determined by an architect or some one else qualified to give expert advice.

The average width of a modern fireplace ranges from 5 feet to 8 feet, according to the size of the room. For public buildings and club houses, where rooms are large, exceptional sizes are frequently found, for harmony in the surroundings is obtained by proper proportion. A large room demands a large fireplace. The height of the mantelshelf and the chimney breast are likewise dependent upon the size of the room and the height of the ceiling.

What features of a fireplace are of chief importance both in design and execution? We will name them, and then consider them in some detail.

1. The size of the opening, *i.e.*, width, height, and depth.
2. The arch.
3. The chimney jambs.
4. The chimney breast.
5. The mantelshelf.
6. The fire box, *i.e.*, fire brickwork.
7. The throat.
8. The flue.
9. The hearth.

Next to the size of the whole fireplace the *opening* is the most important point in the design, for after this has been properly determined it is relatively easy to make other features to correspond. The size should be in proper proportion to the breadth of the whole fireplace. Openings may vary in width from 3 feet to 4 feet 6 inches for the ordinary fireplace and range in height from 2 feet 6 inches to 4 feet. There is a prevalent tendency to make the openings too high. This should be guarded against, but it should be remembered that the appearance of height is strongly affected by the manner in which the span over the opening is made.

The *arch* is usually employed to span the opening. Many times, however, a "soldier course" is laid, supported by a steel angle iron as a substitute for an arch, which gives a fairly good appearance. Sometimes brickwork is carried over the opening with stretcher courses laid on the angle iron. This does not appear to the writer to be good practice, for it is not artistic, and does not agree with the proper principle of architecture because the bricks give the suggestion that they are not properly supported.

The best arch to use for the span of a fireplace is the "jack arch". Its straight, neat lines harmonize well with the general character of the fireplace and particularly

the mantelshelf. The points which make the flat arch so favorable are sufficient to discourage the use of the segmental or elliptical arch. As the jack arch is not architecturally strong, it is good practice to support it with an angle iron, for fierce fires may weaken the mortar in time, and loosen some of the bricks in the arch. But the angle iron makes the arch very strong and practicable. A 13-inch bonded jack arch will be suitable for almost any ordinary fireplace. Of course, an exceptionally large opening would require a correspondingly greater depth in the arch. To insure a good job a full-sized detail of the arch should be worked out, in order to give definite lines for a guide to grind the bricks to the proper shape and size. This is particularly important when the bricks are too hard to be cut by hand.

The *jambs* should be sufficiently heavy to give a balanced appearance to the span, and moreover should be wide enough to withstand any outward thrust of the arch, although where angle irons are used as supports this danger is reduced to minimum. The jambs must often be wide enough to contain an 8 by 12-inch flue. The bond for the jambs should be so laid out at the bottom with bricks laid temporarily (dry) across the entire width of the fireplace that the bricks fit in whole when the wall is carried above the arch. This precaution will eliminate the possibility of a piece or " bat " in the center of the wall, a circumstance for which there is never a legitimate excuse.

The *chimney breast* is that part of the chimney above the jambs and opening. The size and proportion of this part of the fireplace afford the opportunity to add beauty and majesty to the whole appearance. It is ordinarily a good rule to build from the jambs to the ceiling. Sometimes panels of brickwork are built in the chimney breast above

the mantelshelf, but plaster casts may be employed. These often show good taste in their manufacture, but cheap decoration and "gingerbread" work should be always avoided. The effect of simplicity should never be lost sight of in building and designing a fireplace.

The *mantelshelf* is a very significant part of most fireplaces. The writer is of the opinion that it is not good practice to have a shelf thicker than a course of bricks if made of wood, slate, or cement material; neither is it a good plan to extend the shelf at the ends so as to reach the corners of the chimney breasts, because ordinarily a fireplace looks better if the straight lines running up from the jambs to the ceiling are not broken. However, this continuous line may be broken to suit individual tastes. A brick shelf of headers is frequently employed supported by two or three corbeling courses. Six or seven inches is as far as these bricks can extend, for unless they are securely bonded into the wall, they will ultimately work loose, particularly when the mortar is very much dried by the constant heat from the fire. A shelf made of tile material or terra cotta will enhance the beauty of the mantelpiece.

Naturally, in the building of a mantel attention should be given to coloring. Colored bricks in great variety are in the market, and also a like variety of mortar colors. The coloring must be determined according to the scheme of interior decoration, which most housewives understand to-day, for the effect of color schemes in the home is being taught by all up-to-date schools in this country.

To get the proper effects of color in mortar and bricks, samples of work should be laid up, or viewed in the rooms of the nearest local Builders' Exchange, or in the office of some brick company.

The *fire box* which makes the inclosure for the fire should be lined with fire brick. The fire bricks should be laid flat, and the frequent practice of laying them on edge should be entirely avoided. They should also be laid on thin fire clay by dipping them, or by buttering them. Fire bricks cannot be successfully laid unless they have been soaked in water, for if the bricks are dry, the fire clay will become hard before the brick is down in position. A hammer is usually necessary to tap the fire bricks into their bed so that they may be solid and tight.

The bottom of the fire box can be laid with fire brick, either with brick laid flat or on edge. Where there is an ash pit, the ash trap should be set in the center about two inches from the back wall.

The bricks for the walls should be laid out dry so that they will fit conveniently and that it may be unnecessary to use pieces, which make an unsightly appearance and are easily burned out. The sides of the fire box should flare from the back a few inches on each side. The back should be built up straight, about one-third to one-half the way, and should then be inclined forward so as to leave the opening at the throat the proper size. Each brick is tilted slightly, and the surface kept smooth. This incline usually extends 4 to 6 inches forward. In large fireplaces, of course, it may be more, depending upon the depth of the fire box. The damper is placed in position bearing upon the back and side walls in the throat.

The *throat* is the most critical part of the fireplace, but the use of any one of a numerous variety of dampers to be found upon the market helps to solve the problem of its proper construction. The trouble with "smoky chimneys" grows mainly out of faulty construction in the throat. The throat should be about 6 inches higher than

the bottom edge of the brickwork that spans the opening; and the draft area or opening in the throat should not be more than three or four inches wide, but should extend the length of the fire box. From the edge of the throat a shelf should project back. This shelf catches the down draft of cold air which is met by the warm air coming through the throat, and this causes a circulation of the air in the flue and produces an up draft. Did not the shelf check the down draft and did not the narrow opening cause a concentration of warm air, the down draft would blow the smoke back into the room. The wide area above the smoke shelf gives room for air expansion and consequently facilitates the reversing of the air currents. If the points observed above are followed, it is easily possible to have successful fireplaces without the use of a damper.

The *flue* is next to the throat in importance. The flue should not be less than 8 inches by 8 inches inside measurements, and all flues should be either plastered or lined with flue lining. Flue linings may be made of either clay or terra cotta. Where there is intense heat it is better to use a fire clay lining, but for ordinary chimney flues either a terra cotta lining or a flue plastered inside is sufficient.

In order to get the right dimensions for the flue it is necessary to "gather" over from each side with four inches of brickwork. This is done by corbeling gradually and in many cases cutting off the bottom corner edge of each projecting course. This "gathering" is then plastered over so as to give a smooth or even surface. No device will make a fireplace a success if the flue is too small to carry off the smoke. In determining the size of the flue it is a good rule to make the "cross section" area of the flue equal to one-tenth or one-twelfth of the

area of the fireplace opening. For example, take an opening 3 feet wide by 2 feet 6 inches high. Multiplying 3 feet (which is 36 inches) by 2 feet 6 inches (which is 30 inches) we get 980 square inches. Consequently, is we divide 980 inches into ten parts, it will equal 98 square inches. A flue 8 inches by 12 inches equals 96 square inches and is so close to the 98 square inches that it is sufficient.

Another rule for determining size of flue is to allow 13 square inches of flue area for every square foot of opening. With the same opening of 3 feet by 2 feet 6 inches we have 7½ square feet. Therefore, since we allow 13 square inches for each square foot we must multiply 13 square inches by 7½, which will give us 97½ square inches for the flue area. As 8 by 12 inches equals 96 square inches we see that that is sufficient for the flue. A separate flue should be built for each fireplace.

The *hearth* adds attractiveness, and also diminishes the fire hazard. Above the ground level the hearth is supported by a trimmer arch or a stone or concrete slab. The carpenter "trims" the joists, and builds in the center to support the arch, as shown in the accompanying drawing. (Diagram 38.) Upon this arch should be a base for the tile bed, made of a mixture of concrete (1 part cement, 2 parts of sand, and 4 parts of broken stone, called "aggregate"). This base should leave 1½ inches or 2 inches for the tile laying. This is sufficient for the ordinary tile hearth, but a bricked hearth would require a greater depth.

For an open fireplace a glazed tile hearth is impractical, but a 6-inch square Colonial tile, sometimes spoken of as Promenade tile, is suitable to brickwork laid with a wide joint colored to harmonize with the surroundings.

Bricks laid in the hearth will usually give the best

effect if laid in a diagonal bond, *or herringbone* bond (described in Chapter IV).

Sometimes the hearth is laid in concrete. This is not to be recommended, for the appearance is not so good as a paved hearth, and moreover it is more susceptible to cracks from settling.

To lay a tile hearth it is necessary to have for the bed a mixture of one part cement to two parts of sand. This should be leveled off by a straightedge about a foot longer than the hearth. This can be notched to level the cement to accommodate the tile. Upon this surface should be scattered some dry, "neat" cement. Upon this the tiles, after being well soaked in water, can be laid according to the pattern desired. As the tiles are beginning to set they should be adjusted if necessary, and then with a solid block of wood hammered tightly on their bed, and at the same time well leveled. The joints may be filled either by grouting or by pointing with a trowel. After grouting, the tile must be cleaned off with sawdust, and this must be done before the cement is set. This cleaning must be thoroughly done in order to avoid a dirty, smeary finish when dry.

The brickwork beneath the fireplace runs through the basement and contains a hollow shaft which can be used as an ash pit. At the bottom of the ash pit is a cleanout door, which should be large enough to accommodate the ordinary shovel for taking out the ashes.

One side of the chimney breast usually contains an 8-inch by 12-inch flue for the furnace. This is separated by a 4-inch wall from the ash pit.

Fireplaces are frequently first roughed with common bricks, and later veneered with face brick. In this case a segmental arch is usually employed, although a gauged jack arch must be used in the face work.

Where the fireplace and chimney comprise an independent unit, as in a frame house, the exterior of the chimney should be built in good proportion. The racking

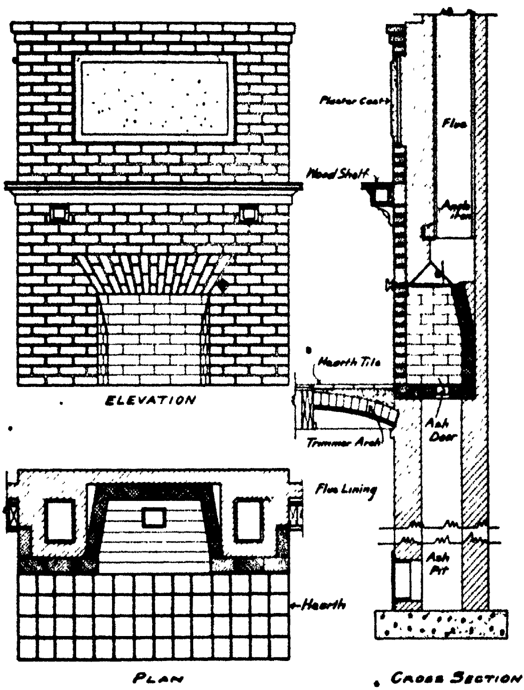

DIAGRAM 39. — Fireplace; showing two views and working details.

back to the chimney line should be only gradually performed and not until a height is reached greater than the top of the mantel.

It is sometimes necessary to clean the face brickwork of the fireplace, and this can be done by a brush, with a wash made of a mixture of four parts of water to one part of commercial muriatic acid. The acid should be kept away from mortar joints to avoid their discoloration.

The working drawing on page 81 gives an example of a modern type of fireplace. The plan is shown on the lower left-hand corner and the elevation at the upper left-hand corner with a cross section at the right of the page.

Some special features are shown which will reveal themselves upon a close study of the drawing. Note, for example, the projecting courses at the top of the elevation, which are provided to add attractiveness to the appearance. Also notice the corbeling over the ash pit, closing in the top so as to leave a small opening for the ashes to fall through and to accommodate the small trap door which is secured on the floor of the fire box as suggested above.

For assistance in reading this drawing consult directions for reading plans on page 102.

Raising a corner or lead. Every practical bricklayer once in a while gets the order to "raise the corner", sometimes called "running up the lead". Since this is a special job it is well to draw attention to some of the fundamental steps that must be taken, and the points which must be heeded to enable a mechanic to perform this phase of his work in a competent way.

The corner should always be commenced by determining first the proper bond. That can be done by laying out the bricks (dry) from corner to corner. This being done it is then necessary to find out how many courses of bricks will be contained in a given height; in other words, to determine how thick the mortar joints are to be made. This can be done by a gauge stick or a story pole

with the courses and bed joints properly marked on it, as well as the marks for the height of the window sills, panels, lintels, projecting courses, story height (height for joist). A little precaution in this respect will enable the bricklayer to avoid many possible difficulties.

With the aid of the square lay out the first few bricks on the corner, so that they will line properly with the other corners of the building. Ordinarily, the first course should be a header. It is good practice on the first course to lay out about three feet. This is less than the distance of the usual bricklayer's level, which he also uses as a straightedge. Each course should be both leveled and straightedged. After laying three courses the corner should be accurately plumbed.

For American bond raise the lead about seven courses high on the outside, which will bring the corner "header high". With many other bonds this is not so conveniently done. The last course should have the three-quarters laid so as to be a reminder of the heading course, which is sometimes inadvertently forgotten. When the outside course is laid up " header high " the corner should be carefully plumbed. If the mechanic's eye is good, it should be easy to get the corner brick plumb after the first three have been accurately plumbed, but the test must be made. Each corner brick should be carefully sighted while being laid, for this will make the plumbing of the corner much easier. In laying up any part of brickwork, sighting with a careful and steady eye should be a constant practice. However, to sight accurately is an accomplishment which comes only by considerable practice, but in due time one should be able to " run up " a corner the length of the plumb rule with no other guide than the eye. The plumb rule should be used only to check up the inaccuracies of the eye.

When the plumbing of the corner requires much hammering, it is better to use the brick hammer than to spoil the handle of the brick trowel. Another point to be observed in plumbing a corner is that the best practice requires one to use the full length of the plumb rule, and to see that each corner brick touches the line. Since there is a tendency in green brickwork for a corner to overhang, it is better to plumb the corner a trifle scant.

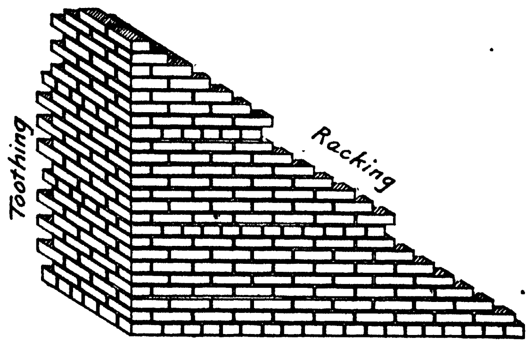

DIAGRAM 40. — This shows a corner of American bond. The reader should note the toothing at the left and racking at the right, spoken of elsewhere in the text.

When the corner has been plumbed, the racking or steps in the lead should be lined up and straightedged.

The individual workman put on the job to raise the lead usually is given some start so as to get ahead before the other men begin to work "on the line" between the corners. If the corner man has a good start, he should work on the line, after he has raised the outside of the lead, until the lead is nearly worked out. He should then proceed to "back up" or lay the inside courses;

and while the other men are backing up their face work, the corner man can go ahead and work up the outside of another raising of the lead. The cross joints should have the same thickness as the bed joints and both should be uniform.

All the corners of the building should be laid according to the same measurement of the gauge on the story pole, or otherwise some bad discrepancies may occur in the courses of brick and the plan of the bond, when the wall is built up.

Joints should be struck while the mortar is fresh, and immediately after the course has been leveled and straight-edged; the cross joints first, then the bed joints.

The line between the corners should be pulled tightly and it is the man on the right end of the wall who raises and tightens the line. Trade practice makes the "right-hand man" the "boss" of the line. The man on the other end should not meddle with the line until he is called. After he gets the signal, however, he raises the line one course, and shouts "Right away"! or some such expression and then the other man tightens the line. Some bricklayers prefer a signal rather than a shout, so frequently the "boss" of the line gets his signal from the other man in the form of a wave of the brick trowel.

Ornamental brickwork. Brick lends itself readily to ornamental effects. Arches, pilasters (piers built into wall), belt and string courses, corbeling, and panels are features in ornamentation. Considerable opportunity for surface ornament is presented by color schemes in pattern work.

In many cases special mold bricks are made for ornamental purposes, but these are not always desirable because they so often warp or have slight irregularities and do not line up true and straight. Plain bricks are usually more satisfactory.

A *belt* course is a course projected on the face of the wall which is so named because it suggests the appearance of a belt. This is sometimes called a *string* course, or a *sailing* course.

Corbeling is the term used to signify the projecting courses of bricks designed to carry some load. It may be to support the gutter that receives the water from the roof, or it may be to receive a wall plate and it may have other similar purposes. The bricks in every corbeling course, in order to carry weight, should extend back into the wall as much as possible; and this calls for the use of headers. For ordinary projections the first continuous projecting course can be a stretcher, but it should not project more than two inches. Corbeling should be done gradually, ranging from ¾ to 2 inches in each projecting course. However, no corbeling should extend more than the thickness of the wall, for heavy corbeling has a tendency to throw the wall out of balance and thus we run the risk of having the wall fall. Corbeling should be well backed up and bonded at each course, and the joints filled flush. For example of corbeling see diagram 41.

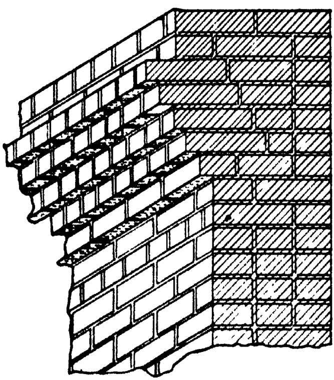

DIAGRAM 41.—Example of brick corbel. Note how the bricks that form the corbel extend back into the wall as far as possible.

Panels are certain definite areas in the walls where bricks are laid to produce artistic effects. These are

each so individual and so capable of an infinite variety of different schemes that no rules can be laid down respecting them. However, they require good workmanship and care should be taken to see that the panel is properly tied in to the main wall, and that the pattern should be carried out consistently. It would be wise, therefore, to have the design sketched on paper as a guide, if it is not drawn to actual scale.

Toothing. Toothing is the method of leaving the end of a section of the wall which is to be continued at a later time. Every other course shows a projection, so that when the new piece of wall is constructed it can be properly tied in. (See diagram 40.) Where the projections are as much as four inches, which would be the case in a wall of American bond, the possibilities of tying in and making a good job are not very great. With Flemish or Old English bond which requires only projections of about two inches, it is quite possible to do a good job in building into the toothing. When building the wall to leave toothing, care should be taken to clean out the pieces of hanging mortar. Moreover, the ends of the joints should be flushed solid. The end bricks of the toothing should be kept plumb, so that the wall can be kept in line.

In tying a new wall to an old one, it is customary to cut out recesses from four to eight inches deep for a height of from four to eight courses of bricks, and then for the next equal distance to build to the face of the old wall, and then to repeat again the same process until the wall is built up.

Window sills and jambs. A window sill is the top part of the wall below the window frame and is designed to shed the water from the wall which runs down the face of the window. If made of bricks, the bricks should be laid on edge and cement mortar joints laid flush. The bricks

should have a slight tilt forward and project from one to two inches. When the window sill is made of stone, the stone should be bedded at each end, leveled, with the face plumb. Mortar is left out from the middle of the sill so that the weight of the jambs — that is, the brickwork next to the frame — when causing a slight settlement, may not break the stone sill, as might happen if the middle of the sill did not have a sufficient corresponding weight.

A *jamb*, which is the end of the wall showing at the opening, should be plumbed both on its face and at the end. Even though the corner bricks are laid to a line, there is still sufficient opportunity for the corner to appear ragged unless trued by the plumb rule.

Fire brick. The laying of *fire brick* differs considerably from the laying of other bricks. Fire bricks should always have as little material in the joints as possible. It is better that fire bricks be laid dry with no mortar at all than to give them a joint which can be burned out with the heat. It follows, therefore, that when fire bricks do not fit very well they should be made to do so by cutting. It should be a rule to lay fire brick flat wherever possible, and to lay them always in fire clay. Good sharp tools are required for fire brickwork, but fire bricks can never be laid so as to produce good workmanship unless they are closely fitted.

Racking. *Racking* is an essential part of raising a corner, or reducing the thickness of a wall. It means the method of arranging the bricks so that they present a series of steps. If a bricklayer were to lay up seven courses on the corner for American bond, he would lay, say, four stretchers on the lower course, three and a half in the second, reducing a half brick each time until there would be only a single brick on the seventh and last course. This stepping back is the racking.

With Old English and Flemish bond the racking shows steps of as little as two inches. It is very important that the racking bricks should be lined up, and their faces kept plumb. Unless the racking courses are level the joining of the rest of the wall gives an unsightly appearance. As an example of racking, see diagram 40.

Fireproofing. *Fireproofing* may be any kind of construction in a building which is built of fire-resisting material. The word alone, however, in trade practice usually means the laying of hollow tile floors or walls, or the encasement of iron columns by tiling, all of which is intended to protect the structure from the ravages of fire.

Until recent times the only method of making fireproof flooring was by building a floor of concrete supported by brick arches built between the flanges of the several I beams. This practice, however, results in making floors very much heavier than desirable. The modern fireproof floor, therefore, is designed to be considerably lighter. Accordingly, hollow tiles of various kinds and dimensions are manufactured, all of which are shaped with the purpose of fitting between the girders in the form of a flat arch.

Toward the I beams special tiles are made to fit around the flange. This tile forms the skewback for the intervening tiles. To lay the tile there is suspended from the I beams a floor made of 2-inch lumber and upon this the floor tiles are properly placed in position. After they are laid with good cement mortar in the joints they must be allowed to stand for a period of from 36 to 48 hours before supports are taken away.

Tiles are not difficult to lay because they are manufactured in such shape that they almost fit themselves into position. Sometimes the distance between certain

I beams is different from that between others, and an adjustment must be made by choosing tile of a size to fit, rather than to attempt the cutting of it. It is necessary in laying fireproofing to see that the tiles are down in place, that is, that the surface is flat at the bottom and flat at the top to accommodate the surface floor above, and the ceiling beneath. Care must be taken to fill the joints with good strong cement mortar, which should not be allowed to squeeze out. Since the trowel is used for this kind of work it is usually performed by bricklayers, and where the trade is organized the journeymen insist on it as a part of their work.

Valuable suggestions for the bricklayer. Whenever starting a new piece of work lay out the bond. This means making a trial of the bricks in the given space without laying them in mortar. Space sufficient for the thickness of the cross joints should be allowed.

Corners should be squared when starting and lined with corresponding corners.

Straightedge and level each course of brick as it is laid in the "lead".

Spread the mortar evenly and flush with the outside edge of the course below.

Strike all joints as each course is being laid whenever a trowel joint is used. Cross joints should be struck first and after that the bed joints.

All joints should be kept flush so as to make their striking workmanlike.

In laying to the line care should be exercised not to get the top edge of the brick too close to the line, but to leave a space about $\frac{1}{16}$ inch between the wall and the line. Keep the top edge of the brick even and parallel with the line, but do not "lip" the brick, that is, do not lay a brick whose top edge is a little farther forward

than the bottom edge, for it is possible to lay bricks with the top edge to the line while they are not always perpendicular.

In stringing the line see that it is tightly stretched, or otherwise the wall may show a sag on the bed joints, in other words, it will be out of horizontal. See that the mortar board is placed in the most convenient position for efficient work, and be sure to have the mortar board wet before putting mortar upon it. The mortar should be well tempered and rounded up, that is, kept in a heap in the center.

Keep the trowel free from surplus mortar, for to work efficiently the shank must be kept clean at all times.

When laying the brick push it into position as much as possible by pressure of the hand. If necessary give it a tap with the edge of the blade of the trowel. Very rarely should the handle of the trowel be used for this purpose.

When picking up mortar with the trowel in one hand be sure to pick up a brick with the other. This will save many extra steps and motions, and will facilitate speed, particularly when working on corners, leads, piers, and in backing up.

Before spreading mortar on the outside of the wall, the bricks to be laid should be placed within easy reach at the inside of the wall. On the other hand, when laying on the inside, or when backing up, the dry bricks should be laid on the outside courses. These bricks should be laid up by using both hands at a time. This practice of putting the bricks to be laid on the wall makes it easier to lay the bricks before the mortar becomes too dry, and also eliminates a great many waste motions which accompany the picking up of the bricks from the scaffold at the same time that mortar is spread.

Projecting courses, or corbeling courses, should be leveled or straightedged on the under side or the lower edge, because this is the edge which catches the eye.

When laying soldier courses care should be taken to see that the bricks are laid in a proper position; they must be kept strictly vertical. This is done by testing, once in a while, with a plumb rule.

When for any reason the bond works in a wall so as to necessitate a four-inch piece in the middle, the last two

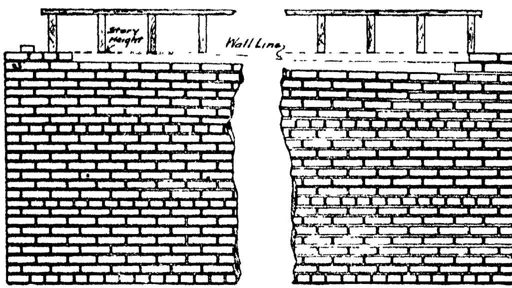

DIAGRAM 42.— Example of "hog" in the wall. Shows the kind of work to be avoided. The prevention is making mortar joints of even thickness and frequent checking of the courses by measurement — keeping the wall level.

bricks should be so cut as to bring into the wall two three-quarter bricks or two six-inch pieces, as this gives a much better appearance than the half brick or four-inch piece.

In raising the line care should be taken to see that the line corresponds with the same course at the other end of the wall, or at the other corner. It is, therefore, wise to count the courses from the level of the sill or from some heading course which runs through the wall to eliminate any possible chance of getting a " hog " in the wall. (See diagram 42.)

When working beside window frames, courses should be so marked on the frame that the brickwork can be easily brought to the level for the lintel and the angle iron or to the proper points to start the skewback at the top of the window frame. If these courses are measured out beforehand, it is easy to vary the joints sufficiently to make the courses come out level.

Test your plumb rule occasionally for accuracy by reversing it for both plumb and for level.

Keep your tools handy. They may be kept in a tool bag near your work, but small tools, such as the hammer, pointer, or brick set, may be kept under the mortar board.

When laying to the line be sure to cut off surplus mortar with a short, quick swipe and with the same motion "throw up" the cross joint. While that is being done, reach out with the left hand for another brick and in laying the bricks avoid wasting any motions. This economy of effort can be accomplished very well with a little practice and thought while working, and as a result much speed can be attained.

To lay bricks fast your movements must be studied and every unnecessary motion eliminated; the tool processes must be quick, snappy, and accurate, and a constant but steady effort must be maintained, or what is sometimes called an "even gait". Be sure to do your work the very best you can and remember that neat work speaks well for the personal characteristics of the individual performing it. On the other hand, slovenly, careless work also denotes corresponding characteristics in the individual.

Good-will among your fellow men is absolutely necessary. Be congenial, be a willing partner. Meet your partner on the wall halfway, if possible, in all your work.

SUMMARY

1. The building of a fireplace requires attention to these details: size of opening, arch, jambs, chimney breast, mantelshelf, fire box, throat, flue, and hearth.

2. Building a corner is an important part of a bricklayer's requirements, and he should learn to build the corner plumb, with the correct bond, and in a reasonable period of time. The corner man is the leader. If his corner is out of plumb, or out of line, it will affect the workmanship of the whole wall. This bricklayer has responsibility which should be met by competency.

3. All brickwork is subject to certain phases of ornamentation, such as corbeling, panel work, belt, and sailing course. Corbeling and sailing courses should be lined up from the bottom edge. No corbel should project more than the thickness of the wall.

4. Toothing, which is the manner of leaving a wall to be joined by other brickwork at a subsequent time, should be kept level and plumb at the ends and the joints should be flush. Toothing should be avoided if possible, as it does not make for good construction with common bond. It is more permissible with Flemish and Old English bond.

5. Window sills should be set with a bed at each end, with the mortar left out from under the middle, so that a settling of the wall will not break the window sill in the center.

6. The essential point in the laying of fire bricks is to see that they are closely fitted together and laid in fire clay.

7. Fireproofing is a method of laying large hollow tile in floors or partitions, designed to be light in weight, as well as capable of resisting fire. Particular skill is required in picking the tile to fit rightly, and to see that the joints are well filled with good cement mortar.

8. Suggestions for practical bricklayers are given as "Trade pointers" which cannot be well classified under other heads.

QUESTIONS FOR STUDY AND DISCUSSION

1. Draw to scale two or three elevations of a fireplace. Compare a drawing with the mantelshelf projecting at each end with one whose mantelshelf comes only within two inches of each end. Compare a drawing of a tall fireplace with one which is short and broad.

2. Take notice of the fireplaces that you see in daily life, and consider in what points you could make improvements.

3. If you find a smoky chimney determine whether or not the principles laid down in this chapter have been violated.

4. Take notice of buildings that you see around you, to determine whether you can discover the evidence of the lead on the wall; in other words, to determine how well the wall was blended into the corner which was raised first as a guide. Notice also whether the courses line up from corner to corner and observe the difference between good workmanship and workmanship that is not good.

5. What would you consider to be the objection to having heavy loads resting on corbeling brickwork? Study the corbeling that you see and give your judgment as to the proper proportion of corbeling courses.

6. Why is it the practice to bed a window sill at each end and leave a hollow space under the middle of the sill?

7. Why should fire bricks be laid tighter than other bricks?

8. Why is tile preferable for fireproofing material to steel and concrete?

9. What are some good suggestions that you can give for practical bricklaying?

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CHAPTER VI

THEORY OF THE TRADE

Trade drawing. Drawing is necessary for bricklayers' work. The bricklayer is sometimes put in a position where he himself must work out a problem in bond. He may find himself in a position where the bricks do not work out as designed in the specifications, and, at the same time, he may want to make the work present as favorable an appearance as possible. Such a situation will oblige him to place on paper a statement of problems unsolved and attempt to solve them. It is not necessary, however, that a bricklayer should be an architectural draftsman. He should know a plan when he sees one and should be able to measure from it. He should recognize readily the elevation of a plan. He should also understand the detailed working drawing, as well as learn to appreciate the problems in perspective which will help him to picture his work as it should appear when completed.

A *plan* is a drawing of the floor area of a building made according to definite measurements reduced to scale. A foot measurement is indicated by (′), as for example, five feet (5′). Inches are indicated by (″), as for example six inches (6″). Five feet six inches would be expressed 5′ 6″. If it is desired to represent on paper a building one hundred feet by fifty feet, with a wall one and one-half feet in thickness, this could be shown on paper with lines drawn to the scale of one-eighth inch

to a foot so that a line measuring twelve and one-half inches would represent one hundred feet, and fifty feet would be represented by six and one-quarter inches, and the thickness of the wall by a measurement of three-sixteenths of an inch. (Cf. diagram 44.) This drawing to scale is a simple process. A man making scale drawings must imagine that a half-inch, a quarter-inch, or a sixteenth of an inch, or whatever scale may be chosen, represents a foot on the building, and inches on the building would be represented by the twelfth part of the distance chosen

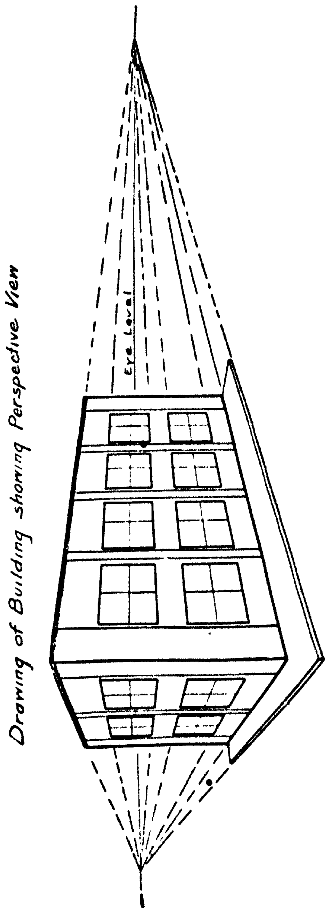

DIAGRAM 43.—A perspective of a building, showing how the horizontal lines converge to a point level with the eye. See text, page 103.

on the scale to represent the foot. The ordinary ruler which the bricklayer may have will be sufficient to measure the plans of the architect, if it is necessary for him to do so, so as to indicate what size parts of the building actually are.

In *elevations* the principle of measurement is the same as for plans, but the elevation shows the upright appearance of the wall with reference to its measurements in height.

Working drawings are drawings which give certain working details; for instance, a drawing showing the bond of the brickwork in a pier would be a detailed working drawing, or a section showing how the interior of an arch is constructed would likewise be a detailed working drawing. It is a picture from which the mechanic can get exact ideas as to the method to be employed in performing a particular piece of work. This sort of drawing is usually on a larger scale than the general plans and elevation. For example, while the general plan might be represented on a scale of one-eighth inch to a foot, a detailed working drawing might be represented by the scale of one whole inch to a foot.

A *perspective drawing* is one built upon scientific principles which have no doubt grown out of a sound knowledge of optics. These perspective drawings present to view the ultimate appearance of the building under construction, as laid down in the plan. They are usually sketches, although, for architectural purposes, they are very often worked out with scientific detail and very accurately performed.

Detail of plans and blue prints. Plans are first made on semi-transparent paper, or cloth which is treated with a glazing coat that will take ink. When held to the light and viewed from the blank side the lines of the

drawing can be plainly seen. The original drawing thus prepared can be reproduced on blue print paper in as many copies as desired, and the original, or tracing, can be preserved for additional prints and for purposes of record.

This blue print paper is a commercial white paper treated with chemicals on one side; it is protected from the light until put in use.

To make a blue print the original drawing on transparent paper or cloth should be laid over a piece of blue print paper of equal size; they should then be clamped tightly together and exposed to a strong light for a suitable time (determined by experience and the intensity of the light). The blue print paper is then subjected to a fixing bath and wash, and when dried is ready for use.

The mechanic should take care not to expose blue prints unnecessarily to sunlight or allow them to become spotted with lime, cement or mortar, as any of these will turn all the blue surface white, bringing about the disappearance of the lines of the drawing.

Various kinds of lines and markings are used, as shown in diagram 44. There are (*a*) heavy, full lines which are usually construction lines indicating the outline of the object or building. (*b*) light, full lines, which are used as dimension lines, (*c*) a series of dashes, (*d*) dots and dashes used to indicate an object, or part of the building above or below, or otherwise concealed by the object or part of the building which is in view. Thus, we have shown in diagram 44 heavy solid lines "a" indicating the outlines of a fourteen-inch wall in a plan showing a one-inch air space; also lines "b" indicating the outlines of the footing supporting the wall below the basement floor and the earth outside; also light solid lines used in connection with measurements.

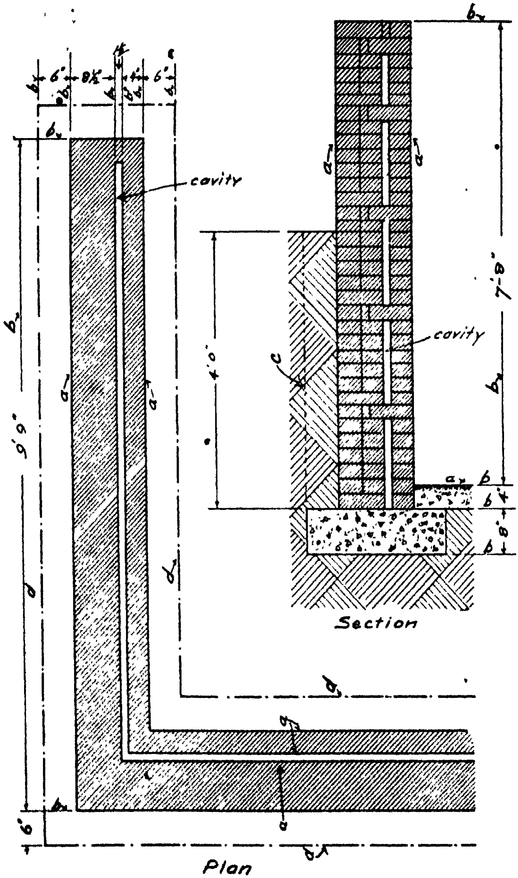

DIAGRAM 44. — Showing a portion of a plan view and a section view. Refer to text matter for interpretation.

In diagram 44 it will also be noted that the space between lines marked "a" is filled in with a series of diagonal lines of nearly equal spacing called "cross hatching", which indicates the solid work of the brick wall with the one-inch air space between the two layers of the wall. Various means are employed by the draftsman to indicate different materials, for example, a space shown filled in with separate squares or rectangles may indicate a hollow tile wall; stippling may be used to show that stone is the material employed, and again, stippling with irregular figures to designate concrete work, and double cross hatching for terra cotta, and crazy diagonal lines to indicate wood.

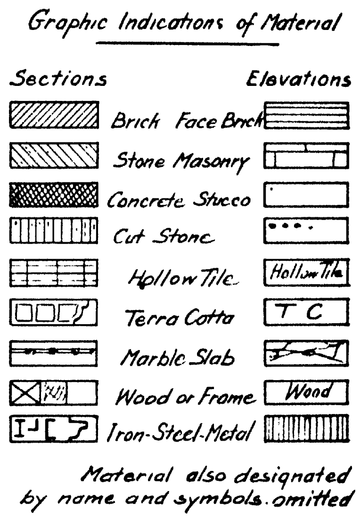

DIAGRAM 45. — Some symbols used by draftsmen of building construction.

In addition to the above, a system of coloring may be employed to indicate the various materials to be used; for example, the spaces may be filled in with red coloring to indicate brick, brown for terra cotta, neutral for stone, yellow for wood, etc. All draftsmen, however, do not use the same symbols, and they therefore show by a key on the drawing the meaning of their own particular sym-

bols, similar to diagram 45. Such a key to the reading of the drawings is called the " legend ". Not a few architects and draftsmen prefer to use no particular figuring or coloring, but rely upon the specifications as a guide to the materials to be employed for the different parts of the work. This is a matter of local custom and practice.

It will be well for the beginner to have firmly fixed in mind this fact in connection with brickwork, namely, that what is nominally called a wall twelve inches thick is actually twelve and three-quarters inches to thirteen inches thick, and is almost universally shown and figured on plans according to the figure the wall actually measures. This also holds good in the case of a seventeen-inch (nominally sixteen inches) wall and a twenty-one-inch (nominally a twenty-inch) wall, etc. This discrepancy is due to the vertical mortar joints between the various four-inch layers of brick. In estimating brickwork, however, the nominal thicknesses are used, as will be noted in the section on estimating.

Reading of blue prints. In reading plans the first matter that should be ascertained is the scale to which a drawing is made. This is generally shown on each sheet of drawings. When one is dealing with scales of one-fourth, one-half, or one inch to the foot, the ordinary inch ruler is an easy guide, but when using other fractions of an inch it may be necessary to construct, or to obtain, special scales, but the principle of measurement is always the same. The relation of one point or object in the plan to another is generally given in figures. The figures should be used instead of the scale as a rule, and if it is found that the figures are not correct, the matter can be laid before the draftsman for correction. To avoid large errors the scale should be kept well in mind. A plan, for example, is made of a large building with

thick walls at a scale of one-eighth inch to the foot. Suppose a preconceived idea of the work leads you to imagine that it is smaller in size than it actually is. Perhaps you fail to note the scale to which it is drawn and might naturally use the one-quarter inch to the foot scale in taking off measurements. What will be the result? The actual floor area will be four times the amount that you have measured, and the lineal feet of wall and its height and thickness are once again as large. This means that there is actually eight times more cubic feet of wall than you have estimated. It takes less time to be sure you have the right scale than would be required to lay the difference between eight thousand and sixty-four thousand brick.

Since the function of the workman is to reproduce in brick, stone, or whatever material is indicated the object which has originated in the mind of the architect, it becomes necessary for the mechanic to be able to visualize the object — the finished product. In other words, with a cultivated imagination he should see the thing in "his mind's eye". The plan is only the expression or means of conveying such a thought.

Perspective sketching. Perspective sketching can be practiced to advantage by the bricklayer by observing the appearance of buildings, or parts of buildings, as they show themselves to him. It must be remembered that the difference between perspective sketching and other kinds of drawing is that the picture is made not according to actual measurements, but according to what the actual measurements appear to be. To illustrate, one may look down a railway track and the rails appear to meet in the distant view, but everybody knows that the rails do not actually meet, but what is observed in this particular instance is the appearance, the perspec-

tive view, and a bricklayer must always distinguish between what a thing may measure and what a thing may appear to measure. Perspective drawing is a drawing of appearance. Perspective sketching is a fine practice to develop a sense of proportion, and this faculty of getting correct proportions means the difference between the artistic bricklayer and the one who is inartistic in his workmanship. (See page 97.)

Methods of measurement and calculation. Measurement of brickwork is obtained by a few simple rules. It is necessary to understand that there are three processes in measurement. First, what is known as the *foot run*, which relates to length. Second, the *square foot*, which not only represents measurement in length, but also a foot in width, so that the square measure of a brick surface 8 inches by 4 inches would be the result of the multiplication of the length and width, *i.e.*, 8 multiplied by 4, giving 32 square inches. The third system of measurement is the *cubic foot*. This would mean the whole contents of a brick, *e.g.*, the brick which is 8 inches long, 4 inches wide, and 2 inches deep or thick measures in cubic inches the product of the length, 8 inches, multiplied by the width, 4 inches, by the depth, 2 inches. Diagram 46 represents three different kinds of measurement.

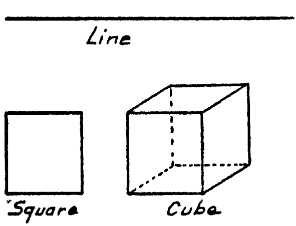

DIAGRAM 46. — Representations of the three methods of measurement.

Brickwork, pointing, etc., may be measured by one or by each of these three processes. For measuring the length of a wall or in measuring to find how many bricks are

necessary to lay out the length of a given wall, the foot run or the lineal foot measurement is taken. This represents the ordinary method of measurement known to the bricklayer. If, however, a bricklayer wishes to find out how many superficial feet he has laid up, that can be accomplished by taking the foot run or lineal foot measurement on the length of the wall multiplied by the measurement of the height of the wall. If the workman is building a pier or a brick column or the like and desires to know the cubic feet of brickwork, he must take the length and multiply it by the width and then multiply by the thickness. For example, if a brick pier is 6 feet high and 3 feet long and $1\frac{1}{2}$ feet thick, the cubic feet in the pier would be obtained by multiplying 6 by 3 and then by $1\frac{1}{2}$, which would be 27 cubic feet.

As indicated below, it is easy to calculate the number of yards, both superficial and cubic, or, in knowing the yards, to determine the inches or feet when necessary. The methods of calculation are necessary to determine the number of courses to be contained in a given height of wall. If the bricklayer knows in the beginning how many courses he must get in, in a given height, he will then know the size of mortar joint to use and can measure from time to time as the wall proceeds to see whether or not he is keeping within the proper gauge. Again, if he is able to calculate properly, he may discover in advance the proper number of bricks to be used in laying out the bond on a certain length of wall. Being able to calculate the height to which his brickwork must go, the bricklayer can work so that when his wall is high enough for the window sill, he will find his brickwork level and ready to receive the sill; when it is "frame high" it will be level with the top of the window frame and be ready to receive the lintel or arch; when it reaches "story high" it will,

likewise, be ready to receive the floor joists and it will not be necessary to split the bricks to give the desired level. Failure to accomplish this has caused many a bricklayer to be " fired ".

Without proper measurement and calculation bricklayers building corners frequently get what is known as a " pig in the wall ", sometimes called " hog ". This term is used to denote the situation where a bricklayer on one corner of a building gets into a given height a different number of courses from the bricklayer on another corner of the building when both corners should have the same number of courses. This " pig " throws the wall out of level and is a very bad feature to find in any building. An illustration of what is meant is shown by diagram 42.

A knowledge of arithmetic is necessary in order to use the builders' tape to advantage. The measurement by the tape, however, is chiefly that of lineal foot measurement.

Some rules to be remembered in computing measurements are that

Inches multiplied by inches will give square inches.

Feet multiplied by feet will give square feet.

Yards multiplied by yards will give square yards.

The mechanic should not multiply feet by inches, nor feet by yards, because this gives him no information whatever and will surely cause him distress. If he wishes to obtain square measure he must first find out both measurements in the same terms, that is, they must both be feet, or yards, or inches, as the case may be, before the multiplication process can begin.

We have spoken only of multiplication, but in order to get the proper results from our multiplication process we must also know how to divide. For instance, suppose we have found that a wall is 6 feet high and 24 feet long,

and we desire to know how many square yards there are in it. We can find this out in two ways. One way is to find out how many yards there are in each dimension, and then multiply these dimensions, and the other method is to find first the total in square feet, and then to divide by the number of square feet required to give a square yard. An example of each process is given.

Example I

Height of wall	6 feet
Length of wall	24 feet

6 feet × 24 feet = 144 square feet.

From our table of square measure we learn that 9 square feet make one square yard. Consequently, we divide 144 square feet by 9 and get 16 square yards.

Example II

Height of wall	6 feet
Length of wall	24 feet

From our table on lineal measure we learn that 3 feet make a yard (not a square yard). Therefore, dividing the height, 6 feet, by three we obtain 2 yards. Likewise, dividing 24 feet, the length, by three we obtain 8 yards. To find the square yards, then, we multiply 2 yards by 8 yards and get the result, 16 square yards.

Of the two methods given the most practiced and perhaps the safest, from the standpoint of accuracy, is to get square feet first, and then divide by nine to obtain the square yards.

To find cubic measure the same principle can be employed, but care should be taken in each case to use the table that pertains to the kind of measurement desired. When cubic measurement is taken, we should be sure to use the table on cubic measure.

Example

Find cubic yards of a wall 6 feet high and 24 feet long, 2 feet thick.

Height of wall	6 feet
Length of wall	24 feet
Thickness of wall	2 feet

Cubic feet in wall, 6 feet by 24 feet by 2 feet equals 288 cubic feet.

From our tables we learn that 27 cubic feet make one cubic yard; therefore, we take 288 cubic feet and divide by 27 to get cubic yards.

$$\begin{array}{r} 27)288(10\tfrac{18}{27} \\ \underline{270} \\ 18 \end{array}$$

The result shows 10 and $\frac{18}{27}$ cubic yards. Since $\frac{18}{27}$ equals $\frac{2}{3}$, we can give the result as $10\frac{2}{3}$ cubic yards.

Estimating material and expense is all based upon the fundamental principles of arithmetic outlined. To provide a basis for calculating costs, it is necessary, however, to know the amount of material contained in a given unit of measurement. Should the bricklayer have any difficulty with this sort of arithmetic or mensuration, he should get a book on arithmetic and study these processes in more detail.

Estimating. Estimating is divided into two branches, first, *quantity surveying* or taking off, or calculating material and labor to be used; and, second, *pricing* the various items.

To show how quantities are surveyed, we will work from the drawing given on page 109.

The exterior of the walls measures 20 feet in width by 40 feet in length. The footings are laid 6 inches below the surface of the ground. The wall is 9 feet high from

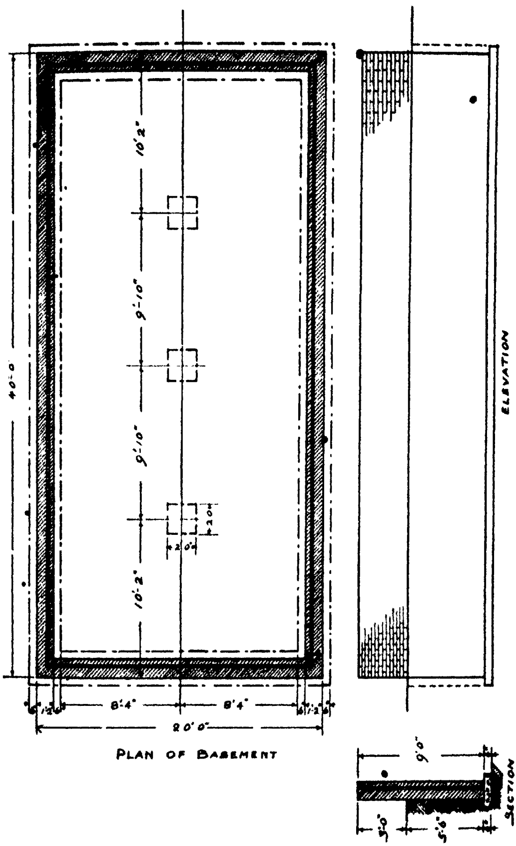

DIAGRAM 47. — Showing plan, elevation, and section of basement.

the top of footing to top of wall. The footing projects 6 inches beyond the outside of the wall.

Since the first item to determine is the amount of excavation, the cubic contents must be obtained. As the area of the building is 20 feet by 40 feet we know that there must be at least an area of 800 square feet. However, this is not wide enough, because the footing projects 6 inches beyond the outside of the wall all around; therefore, we must add to the measurement of both the length and width one more foot. This gives an area of 861 square feet. Now since the depth of the foundation is 6 feet we must multiply 861 by 6 feet to give the cubic feet of excavation, which is 5166 cubic feet.

The footings are shown by the drawings to be 26 inches by 6 inches and the length around the building as 120 feet (disregarding corners). Together with the interior footings for posts we have the following items:

Concrete footings, 120 feet by 26 inches by 6 inches equals 130 cubic feet.

Three concrete post footings 2 feet by 2 feet by 6 inches equals 6 cubic feet.

This gives a total of 136 cubic feet.

These footings require a wood form, except at the edge of the excavation. The items then for concrete forms for the outside walls are 120 feet by 6 inches equals 60 square feet; three concrete forms for post footings, 8 feet by 6 inches equaling 12 square feet. Therefore, total square feet of concrete forms equals 72 square feet.

The wall is shown to be 14 inches thick including a 1-inch air space; this would mean that the wall is built of two 4-inch layers of brick at the outside and one 4-inch layer inside, with the air space between. The two layers of brick which, of course, includes the mortar between them, and the air space measures a total of 14

inches; however, the nominal thickness of the wall is only 12 inches. Our item then is as follows:

Common brick wall, 120 feet by 9 feet by 1 foot equals 1080 cubic feet.

When all items are surveyed and amounts listed and totaled, they can then be priced.

It is obvious that in order to put a price on the cost of a given item, the estimator should have definite information as to the cost of the needed materials delivered on the job. He must also exercise sound judgment as to the amount of time required to work up the materials, and must know the equipment required to aid in the work. There are also other cost factors that must be considered, such as extreme weather conditions, workmen's liability insurance, overhead costs, and the like.

An example of the analysis of cost factors is given below. With the plans and specifications as a guide to the working conditions, we must secure prices on the following various elements. Cost of:

Common brick, delivered, per thousand.
Lump lime, delivered, per bushel.
Portland cement, delivered, per barrel.
Sand, delivered, per cubic yard.
Liability insurance — premium percentage of payroll.

When the cost of a unit of the various materials is obtained, it is then necessary to determine the total amount of those units. Accordingly, a multiplication of the quantity of units by the cost per unit gives the estimated price of the building. The following materials and elements in construction are figured according to the statements below:

Excavating by cubic feet.
Common brick by cubic feet.

Face brick by square feet.
Pattern brick by square feet.
Stone work by cubic feet.
Moldings on stone work by lineal feet.
Terra cotta by square feet.
Concrete by cubic feet.
Concrete forms by square feet.
Cement facing by square feet.
Hollow partition tile by square feet.
Drain tile by lineal feet.
Clay wall coping by lineal feet.
Clay chimney lining by lineal feet.
Cement plaster waterproofing applied to walls by square feet.
Washing down and tuck pointing by square feet.
Various kinds of arches by piece.

These units are used because the foot measurement is the standard of all measurements in this country, and is employed by architects, estimators, and mechanics. This makes the problem simple for the estimator, since it requires only four different units to appear on the estimate sheet.

Wage rates per hour to be paid the mechanics are determined by local data on wages. It is then necessary to judge the number of hours required by a mason to lay one thousand bricks in the specified wall, and the amount of labor required to keep the workmen supplied with materials.

It is these labor factors which present the chief element of chance in estimating. It is possible to have definite knowledge about the quantity of materials and their cost, but the human element is an uncertain factor. Standards set may be lived up to, or may not. However,

a great deal of uncertainty can be eliminated by conditions of evident good-will between a contractor and his workmen. To obtain this condition of good-will requires, among a multitude of other things, a mutual understanding between the employer and employees with reference to working and wage conditions, and the exercise of a spirit of fair play and square dealing on both sides.

When the cost of bricks per thousand, or of lime per bushel, is obtained, it is then possible, after approximating the price of labor, to determine the cost of laying a thousand bricks in a wall.

By experience it is found that the number of cubic feet contained in 1000 bricks laid up in the average brick wall is fifty-five. Therefore, if we wish to find the cost of laying up a cubic foot of wall, we divide the amount determined to be the cost of 1000 bricks laid up, by fifty-five. Then, since we have the cost of one cubic foot, we can determine the total cost by finding out how many cubic feet there are altogether, and multiplying that number by the cost of one cubic foot.

The cost of the other items in the building is arrived at in practically the same way as that used to determine the cost of ordinary brickwork.

Some facts about the action of lime and mortar. Science has revealed certain facts concerning the material which a bricklayer has to use, which, if known, may satisfy some interesting inquiries. The bricklayer sees the lime used up with the sand. He knows that it is wet and plastic and yet he also knows that in the process of a short time it becomes hardened. He naturally wonders, therefore, what brings about this peculiar change.

With these thoughts in mind we venture a few brief comments. Lime, which is the base of mortar, is made from limestone. This limestone is placed in kilns and

burned to a red heat in a burning process called calcination. This process drives off the moisture in the stone and a certain chemical element called carbonic acid. The result of burning, or calcining, is quicklime.

Quicklime is the kind of lime delivered in lumps for building purposes. Before it can be used it must be slacked. Slacking can occur in two ways, by the use of water or by exposing the lime to the air; in the latter case it is slacked by the moisture which is in the air, through a long and slow process which renders the lime unfit for building purposes. When water is thrown upon the quicklime, the lime absorbs the water quickly, and very soon cracks, swells, and falls into a bulky powder, giving off considerable heat and steam. This swelling increases the volume two or three times.

After the slacking and reducing of the lime to powder certain lumps still remain. These are the result of an overburning in the process of calcining, and if they are very frequent the lime should be sieved or at least screened after it is mixed with the dry sand; otherwise, the mortar may be spoiled, particularly so if the mortar is used for plaster.

The calcining of limestone results in the separation of what is known as carbonic acid gas* from the stone, and this takes place so rapidly that the stones crumble to pieces and that is why big lumps of limestone after being burned are in much smaller pieces. Carbonic acid gas always exists in the atmosphere and it is this acid gas element which returns to the lime when exposed in the air in the form of mortar and causes it to take its former hard characteristic.

The manufacture of Portland cement and the manufacture of lime are based on the same principles. Lime mortar requires the air to set, whereas cement mortar

* Known in the laboratory as carbon dioxide.

will even set up under water, having what is known as hydraulic properties. Sand facilitates the working of the lime and cement into mortar, and at the same time affords an opportunity for the air to reach the particles of lime and cement which forms a film between each grain of sand. If the lime were used alone, it would be found that the grains are so small that there is little opportunity for the air to penetrate and a crust would form on the outside, but the lime on the inside would not be reached by the air, and consequently would not set.

Salt water should not be used for the mixture of mortar, because the result is an efflorescence on the wall or on the mortar joints and this is followed by the disintegration of the mortar.

SUMMARY

1. The bricklaying trade requires a certain amount of technical information. This, among other things, comprises a knowledge of plans, elevations, perspective drawings, and elements of quantity surveying, and estimating.

2. Scales are used to indicate the proportions in the drawing to those of the structures they represent. Large drawings are generally made to a scale of $\frac{1}{4}$ inch or $\frac{1}{8}$ inch to a foot, and details are usually worked at scales of a half to 1 inch to the foot.

3. The reading of blue prints is essential to bricklayer's work. It requires a knowledge of the meaning of various kinds of lines and dots and dashes and other symbols used on the drawing. Blue print reading requires a knowledge of the scale and also involves access to the specifications which explain the blue prints. Rather than trust to measurements of lines, it is a good rule always to check up by the measurements given in figures.

4. The measurement of brickwork is obtained by the foot run, the square foot, and the cubic foot methods of calculation.

5. In order to calculate these measurements, a knowledge of such simple arithmetic as adding, multiplying, and dividing is necessary.

6. An essential rule to remember in computing measurements is that inches multiplied by inches give square inches, feet multiplied by feet give square feet, yards multiplied by yards give square yards.

7. The important thing about estimating is to be accurate in the calculation of the quantities; the prices of material must be checked up according to the condition of the market, which fluctuates from time to time. The estimator must never forget that the human element, or the labor factor in the erection of buildings, is the great element of chance, and the certainty of correct estimates on the work of labor depends quite largely on the good-will and consideration shown to the workmen themselves.

8. Lime mortar is made from lime. Lime is the result of burning limestone rock so as to drive off the carbonic acid gas. This burning breaks down the rock-like character of the limestone, and the carbonic acid gas must recombine with the lime before it can again become hard. This chemical change is assisted by the use of sand, as the sand gives better opportunity for the air containing this carbonic acid gas to get around the particles of the lime. In this way the lime, returned to its former solidified condition, forms a film-like surface around the particles of sand, holding them together.

QUESTIONS FOR STUDY AND DISCUSSION

1. Explain a plan; an elevation; a detailed working drawing; a perspective drawing.
2. What is the purpose of a perspective drawing?
3. How are blue prints made, and what is their use?
4. Distinguish the different lines in a drawing and explain exactly what they signify.
5. What are dimensions?
6. What is meant by the foot run, the square foot, the cubic foot?
7. Explain the process of multiplication, of addition, of division. What are the principles to be observed in multiplying inches, feet, and yards?
8. What are the elements in estimating? What is meant by a quantity survey? By pricing?
9. What are the units of measurements for material in a building?
10. How would you estimate the cost of building 600 square feet of wall?
11. What do you know about the action of lime in mortar?
12. How does mortar receive back the gas which was driven off by the burning or calcining of the lime in the kiln?
13. What is the efflorescence on brickwork?

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CHAPTER VII

SAFETY AND HYGIENE

SUCCESS and happiness in work depend more upon safety in work and personal hygiene than the reader may at first realize. In every occupation there are certain dangers to life and limb and to health which must be guarded against. The bricklayers' trade has always been known for its dangers, especially those which grow out of poor scaffolding. The dangers in the trade can, however, be reduced to a minimum if care and intelligence are exercised by those working in the trade.

In most states if the laws are observed there will be little danger of injury from poor scaffolding, or from falling of walls; therefore, the bricklayer should acquaint himself with the laws governing building construction in his community or in his state. He should know what protection the local building code, issued by the city or the state, gives to workmen on the job. He should seek to disseminate this information so that the general public who have to pay for building will be ready to pay for the cost of building proper scaffolds, and generally protecting the life and health of building workmen.

Modern safety devices for scaffolds should be insisted upon. Care should be taken not to use dangerous ladders, and nails should not be left in boards where they are likely to cause some one an injury.

Dangers of frost. Apart from the effects of frost on the person, there is the danger consequent to the use

of frozen material or frozen bricks. Moisture on bricks may be frozen so as to be scarcely recognized. Mortar which may freeze in the setting up or in the laying may be used conveniently while the work is proceeding, but is bound to bring serious results when the thawing takes place. When the thaw starts and the frost begins to come out of the joints after the wall is erected, the weight of the superstructure, that is, the weight of the brickwork above, will cause the mortar to squeeze out and the wall will very soon take a bulging appearance, and in many cases will fall. Considerable danger is encountered in the winter time where frozen bricks and mortar are used, and the lives of bricklayers have many times been sacrificed and in other cases jeopardized by this kind of construction. It is better not to work under such severe weather conditions unless plenty of fire is employed around the mortar boards and sufficient hot water used to keep the lime and cement warm enough to withstand the frost.

Personal hygiene. Of particular interest to the bricklayer are the measures and precautions which will improve or protect his personal health and bodily efficiency. Consequently, a few suggestions are given here concerning the care of the feet, the care of the hands, and the problem of clothing. The dangers due to the effects of frost are also suggested.

The bricklayer knows from experience that lime plays havoc, so to speak, with shoe leather. He early discovers that a good pair of shoes will be rotted by the action of lime, and soon decay, and the tendency is to use any old shoes that will make a covering for the feet, and consider them good enough to work in. This, however, is a grave mistake. The bricklayer needs a strong pair of shoes so that his feet will be well protected from bats and bricks, falling brick hammer, or anything of the sort that might

hit him while at work. Furthermore, he needs a strong shoe to brace up the arch of his foot, which means so much to his comfort and ability to stay on his feet for hours at a time. Every practical mechanic knows that the scaffolds upon which a bricklayer works must necessarily contain from time to time broken parts of bricks known as chips or spawls, and these when stepped upon are usually quite disagreeable. Much of this sort of experience will most surely break down the arch of the foot and bring upon the bricklayer the consequent inability, after a few years of work, to keep pace successfully with a younger man in the trade who has not yet had this misfortune. It may be a little more costly to keep well shod while laying bricks, but it will pay in the end. It is better that the bricklayer should buy strong shoes originally intended expressly for the purpose of working on the wall rather than to attempt to wear out on the wall shoes which he may have purchased for street use or for general social purposes.

There is no reason why a bricklayer's hands should be any more unsightly than those of other people. Being exposed to the open air they will naturally keep a good, healthy color. Knocks and scratches, which make sores on the hands, should be attended to promptly. A cut or a bruise which takes off the skin is bound to produce a condition, if dirt comes in contact, which will greatly spoil the appearance of the hands. Once in a while when the mechanic is home after work he should rub into his hands a combination of water and glycerin which will counteract the dryness and hardening of the skin which follow the constant contact with lime. The writer, who worked steadily at the trade in one period of his life for twelve years, was able to keep his hands in a satisfactory condition by following out these suggestions. He

kept them in such condition that it was quite possible for him to handle the strings on a violin with some facility.

The finger tips will wear out occasionally by handling the bricks during wet weather or when using bricks which have been dipped in water for various purposes, but when the tips of the fingers become tender the bricklayer should acquire the ability to grip the bricks by catching the edge of the brick farther down on the finger, and by the time the second position on the fingers wears tender he will find the tips will be able again to stand the pressure of handling the bricks.

Clothing. It is no easy thing to be able to stand the two extremes of temperature. A bricklayer is called upon to work out of doors in the blazing sun and within a few months may also be called to work in a cutting wind when the thermometer registers below zero. It can be seen very readily, therefore, that the bricklayer must give some attention to clothing. Naturally, what may be particularly good for one person might not necessarily be equally good for another; but on general principles a person working in the open should wear wool. Many bricklayers who have been wearing light cotton underwear in the summer time have gone home overcome by heat, while others who have worn light wool have been able to stand the heat exceedingly well. Evidence of this has come to the writer in his own experience on several occasions.

In the winter time especially it is better to wear wool, because wool is both warmer and lighter, and clothing of wool requires less in amount than would give the equivalent warmth in other material. It is often said by mechanics that if they dressed warmly enough they would have too much clothing for their work. It is very im-

portant, therefore, that the mechanic out of doors should get the utmost warmth out of a minimum amount of material, and he should, consequently, use all the wool that is necessary. This may be covered with light overalls, which protect the wearing which would come by contact with brickwork.

Little can be said here with regard to food, except that individuals engaged in strenuous outdoor work need more food than the individual who works at an occupation calling for little physical exertion; and he is usually in better health. Food should be substantial and wholesome. Every mechanic's family should take advantage of the opportunities to obtain such knowledge and practice in preparing food as may be offered through public libraries, boards of health, and the like.

Intoxicating liquor should not be taken, because men under the influence of the poison of liquor and its interference with the brain's activity are more likely to be hurt through accident. The use of liquor is injurious to health. It cannot result otherwise than in making the mechanic less skillful and more unsteady and inefficient in doing his work. The continued use of strong drink may result in the loss of moral reputation. The mechanic who is interested in his personal health, his economic security, and his moral welfare will avoid the use of intoxicants.

SUMMARY

1. Dangers which grow out of poor scaffolding and carelessness can be avoided.

2. City and state codes, and state statutes, and municipal ordinances are to be found throughout the country, which have regulations designed to protect workmen from building accidents.

3. Personal vigor and efficiency can be furthered by paying proper attention to the feet. Strong shoes should be worn and the arches of the feet kept up.

4. For personal comfort the hands should be kept in good condition, and care and judgment should also be exercised in the matter of clothing to be worn while at work.

QUESTIONS FOR STUDY AND DISCUSSION

1. What are the laws governing safety on buildings in your community? Do you have a building inspector?

2. Can you tell a dangerous ladder when you see one? Have you known or heard of any one who has been injured by a nail carelessly left in a board?

3. Why is wool a good clothing material for both hot and cold weather?

4. How does frost affect the safety of a workman on a brick building?

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CHAPTER VIII

ECONOMICS OF BRICKLAYING

EVERY bricklayer knows that the work that he performs is a necessity, because he knows that the civilization of which he is a part could not be maintained without buildings which protect men against the elements. A suggestion of this has been made in Chapter I. A bricklayer's work contributes directly to the welfare and convenience of man — in short, to satisfy the wants of man. In thus satisfying a human want, for which people are willing to pay a price, he is performing what is called an economic service. The science known as economics or political economy is the science which deals with the wants of mankind and the means of their satisfaction in so far as they are paid for, or demand a price.

What people obtain free from nature we do not regard as coming within the field of economics. The services of a bricklayer, however, are paid for by some one and therefore the bricklayer is a part of our economic society. Our industrial and social life is upheld on the basis that every one who performs productive work is satisfying a human want and performing a service to some one else for which the person satisfied is willing to pay a price. This is the foundation of all our business, and of our whole industrial system. The bricklayer may ask how all this came about, how it happens that we have such a complex society with so many people doing so many different and special things. It is well to remember that it was not always thus.

Buildings have grown with civilization, and the character of the buildings in any civilization has been both its expression and its measure. Some few hundred years ago the world had but few cities, and none of them were like our large industrial cities of to-day. In olden times the chief industry was agriculture, and the families who tilled the soil would also shear the sheep and card the wool, weave the cloth, and fashion clothing for the members of the household. Moreover, it would even fall to them to tan the hides for leather, out of which they could make shoes for their feet. They could, in addition, house themselves in the poetic "lowly thatched cottage", for these cottages were made of reed and straw secured around a simple wooden frame, with walls sometimes plastered with mud and clay. As time passed, however, certain families gave all their time to the tilling of the soil, others to the weaving of the cloth, and still others to the building of the houses, and so on through a number of different occupations. Here began what we term the division of labor. In earlier days the means of getting to and fro from place to place were poor. Good roads, as we know them, did not exist. The railway was not even thought of, and was not destined to appear until many centuries later. Rapid means of communication, such as we have to-day through the telegraph and telephone, were at that time far beyond the possibility of man's thought. All the improvements of transportation and communication such as we now have came gradually through the process of development from the past.

The changes in industry which have caused the agricultural system to make place for the industrial system where millions of people congregate in cities, and where thousands work together in one factory to produce a single article, have all depended upon the development and

improvement of transportation and the means of communication between villages, cities, states, and nations. The development of transportation has gone along with the invention of machinery, the invention of the steam engine, the discovery of electricity, etc., etc., with the consequent increased division of labor, until we have our modern trade and commerce.

Trade and commerce are based upon the exchange of goods, as our articles of production are called. This exchange goes hand in hand with the division of labor. Rather than each of us trying to make all of his own necessities it has proved to be possible for all of us to get more things conveniently if, for example, I give all my time to make a certain thing and you all your time for making another. If I give all my time to making shoes, and you give all your time to laying bricks, I shall be a better shoemaker and you a better bricklayer than if we each tried to be both a bricklayer and a shoemaker. Therefore, you build my home, and I make your shoes, and as a result I get a cheaper house, and you get cheaper shoes. By my devoting myself to the making of shoes exclusively and you to bricklaying, both of us can reduce the time that would be required if we each laid our bricks and made our own shoes. Consequently, this division of labor is economy. It means in the end that both of us will get more goods or services in exchange for the labor that we put in than we could by performing all the labor to make the products ourselves.

The rise in the standard of living of all of the people has grown out of this division of labor and exchange of goods, and it is the increased demand for more and more conveniences that has caused industry to expand to its present dimensions. Without this division of labor, and without this exchange of goods, made possible by improve-

ments in transportation, bringing a consequent rise in the standard of life, the bricklayer would receive in wages only a fraction of what he is getting in wages to-day, and rather than the short eight-hour day he would be toiling from daylight to dark, or like the proverbial housewife his work would be " never done ".

We have already made reference to the development of machinery and the consequent specialization of manufacturing in industry, but let no bricklayer imagine that his trade has not been affected in like manner.

In olden times the bricklayer made his own bricks; that is, he dug the clay out of the earth, he formed it to the shape of a brick, he laid it out in the sun to be burned, and prepared the mortar with which it was laid. If plastering was to be done, he plastered also. The stone mason, the bricklayer, the plasterer, and the tile setter were all in one craft. To-day, however, brickmaking has developed to such an extent that it no longer pays for the bricklayer to spend his time making the bricks. It would be very expensive, it would be slow, and practically impossible because the buildings which we have to-day could never be erected if that proceeding were followed. But machinery has been invented to dig the clay, machinery has been invented to mold the bricks, and kilns have been constructed in which to burn these bricks by a heat far greater than was possible when they were laid out in the sun. While bricks are produced many times more quickly than in olden times, they are nevertheless of far better quality. The bricklayer receives the bricks already made. He does not even put in the concrete for the foundation; that is put in by the engineer before the bricklayer gets to the job. He starts right in to lay the bricks. He needs to know little even about the preparation of the mortar. The mortar is prepared for him by a mortar-

mixer, and whereas in olden times he himself would have to prepare the lime and cement, and the like, from the earth, to-day he leaves that to lime and cement manufacturers. The bricklayer finds also that ordinarily the stone work in the building is performed by another man, — a stone mason or a stonecutter, — who has specialized on that side of the trade and can do it more economically than the bricklayer.

To-day, bricklaying and plastering have developed into such special occupations that the bricklayer no longer attempts to claim plastering as his trade, nor the plasterer to claim bricklaying. This specialization goes on through all the building trades, as any mechanic knows, and the jurisdictional disputes which arise between one trade union and another often grow out of this ever changing movement in our economic and industrial life.

This condition, unfortunately, has led many workmen to the point where they have lost sight of the connection of their trade with all other trades and occupations in the community. A bricklayer falsely thinks, many times, that his trade is absolutely independent, that his trade depends on no other man's welfare, that he can be prosperous when the other man is poor, or the other man can be prosperous when he is poor. These conditions are not fundamentally true. If any class of citizens is poor, the prosperity of other classes of citizens is bound to be affected. If I am a shoemaker and I am very poor, I cannot afford to purchase the labor that would be necessary to build or improve my house, or to have other conveniences that I desire, and therefore I am unable to contribute to the bricklayer's or plumber's or some other tradesman's prosperity. If the bricklayer is poor, likewise, he cannot afford to buy the shoes that I produce so as to make me prosperous; he is unable to hire painters

and decorators to beautify his home. He is, moreover, unable to buy furniture, and, consequently, the opportunity of his fellow mechanic, the cabinetmaker, to get work at his trade is correspondingly lessened.

Every mechanic should get thoroughly in mind this principle; namely, that the prosperity of the other fellow is necessary to assure his own continued welfare. This may not be easy to see at first, but a little study of conditions will make the proposition clear. In other words, a man working at his trade is performing an economic service which is necessary in the community, and if he does not do the best that he can for the money he receives, he is, in the long run, cheating himself.

If you as a bricklayer take a day's time to do half a day's work you will in the end defeat your own game. Imagine if you will every mechanic taking twice as long a time to produce a given article or personal service as it should properly take. What is the certain result? Plainly only half as much will be produced, and if only half as much is produced there will be only half as much of goods or services to go around. That is to say, limitation by the workman of his production increases very materially the cost of living. Consequently, if what we buy costs us more money, we must with our income buy considerably less. Is it not easy to see, then, that if we do not produce all we are able to, we shall all have less in the final result?

If, to some individuals, the distribution of goods or services does not seem to be fair, attention should be turned to other remedies, but never should the fatal mistake be made of thinking that matters can be helped by performing the least amount of service for the maximum wage. The bricklayer must look beyond the in-

dividual employer for whom he works, and think of the whole economic society of which he is an integral part.

There are certain conditions which must be observed in the bricklaying trade which differ from many other occupations.

In the *first* place the processes of bricklaying are not very different from those practiced thousands of years ago. The conditions and processes of most trades change so fast that the ordinary man must hustle to keep up with the changes, but with bricklaying, although some changes have taken place, the fundamentals of the trade are the same.

In the *second* place, bricklaying has not been, and is not now, subject to the competition of women workers, as are many trades practiced to-day. This has made the wage question easier for the bricklayer to control, and has resulted in giving him a superiority in wage bargaining as compared with some other trades which have to meet the lower wage so frequently paid to women workers in a trade.

In the *third* place, it follows from the first proposition that the bricklayer has no competition from machinery. In almost every trade machinery has been invented to do work formerly done by hand; in this trade, however, no machinery has been invented to lay bricks successfully, for so individual and different is every building, and all parts of the building, that scarcely any two conditions of construction are the same, and the invention of machinery to take the place of bricklayers' work is unthinkable. Substitution of other material such as concrete and lumber seems to be the only direct way of affecting the amount of bricklayers' work. The result of the lack of competition with machinery has been to give the bricklayer a certain security in his trade, and again has perhaps helped him in his wage bargaining.

The *fourth*, and most important, feature of the bricklaying trade is the fact that the trade is not subject to foreign competition; in other words, the market of a bricklayer's product is local. To illustrate: if I work in a factory and the product of my toil is a wooden box, that wooden box may be shipped thousands of miles away for a particular purchaser. It may be manufactured just as well at the point where I work as a thousand miles away and perhaps considerably cheaper. On the other hand, when you, as a bricklayer, have performed your work, there is accomplished some mechanical product which cannot be shipped thousands of miles away but must stay in the community or spot on which that mechanical work is performed. In other words, the work that you do as a bricklayer stays there for good or bad on the spot where it was placed. This is a matter of much concern to the community which must see that your work is not a detriment to the people who live where your work is performed. Therefore, communities represented in the government of municipalities, cities, and states make certain regulations with respect to the work of a bricklayer. The community has some right as to the quality of each piece of work; it must be constructed without loss of life or limb; it must not be unduly subject to hazards of fire, etc., for since it is necessary for the government to protect its citizens it must require properly constructed buildings to assure the safety and welfare of the people.

In the preceding paragraphs we have mentioned some of the differences between the trade of a bricklayer and that of some other trades and occupations. It is not sufficient, however, to call attention to these apparent advantages without a word or two concerning the chief disadvantages of the trade of bricklaying. The bricklayer's work is dominated by the elements. Building

must be done in fair weather. Building must be done also so as not to be affected by the sharp frosts of winter. Bricklayers seldom work all the year around. After the severity of winter, work opens up in the spring, sometimes early and sometimes late, and continues far into the autumn. Here and there bricklayers work all winter under more or less sheltered conditions. Generally speaking, however, most of the bricklayers are idle for a great portion of the winter.

Frequently one sees a contrast of the wages of a bricklayer as against, for instance, a machinist. Some time ago in an industrial dispute in a large city quotations were made showing that a bricklayer earned more than a machinist, and the implied argument was that the machinist should be paid at the same rate as the bricklayer. Whatever might be the merits of this particular question, the fact remains that no proper comparison can be made between the earnings of the machinist and the bricklayer on the grounds of an hourly rate. A man working in a shop may work the entire 52 weeks of a year, but scarcely any men on a building can work that long. A machinist may stay with one employer and one shop or department and work steadily at one class of work all through the year. A bricklayer, on the other hand, may have dozens of different jobs. He must move around where the work is, whereas the machinist has the work brought to him. Between jobs the bricklayer very often loses considerable time. When it rains he loses more time. When the snow flies and the thermometer registers below zero the bricklayer must again lose time. This perhaps is one of the chief features which make this trade seem to be undesirable to so many workmen. Bricklayers usually earn relatively good money in the summer time while the work of the trade is on, but

averaging up their yearly earnings the realization on their rate, considered annually, represents only about 70 per cent of what full-time work would yield.

Provided the bricklayer uses his time profitably during the slack months, he will most likely find his trade profitable and enjoyable. It is the man who works in the open air, and who can stand with comparative ease the extremes of temperature, that really enjoys that greatest of all human blessings — good health. Good health is the foundation of success, because through it only can efficiency and happiness be assured. Some suggestions upon this subject have been treated in Chapter VII.

SUMMARY

1. The bricklayer performs an economic service. He satisfies certain human wants for which people are willing to pay a price.

2. Specializing of bricklayers' work has grown up with development of exchange, improvements of transportation, and the consequent division of labor.

3. Four characteristics of the bricklaying trade are: *a.* Processes of bricklaying are practically the same to-day as in ancient times. *b.* Bricklayers are not subject to competition from woman labor. *c.* Bricklayers have practically no competition from machinery. *d.* The bricklaying trade is not affected by foreign competition.

4. Bricklaying work is dominated by weather conditions, and the bricklayer's wages must be high while he works in order to yield a fair yearly income.

QUESTIONS FOR STUDY AND DISCUSSION

1. How is a bricklayer a part of the economic system? Is his work an economic service?

2. What is meant by "exchange"; by "transportation"; by "division of labor"?

3. What are four characteristics which make the trade of a bricklayer different from most other crafts? Explain.

4. How does the weather affect the work of the bricklayer?

5. Compare the wages of the bricklayers in your community with those of other craftsmen. How do they compare at the end of the year?

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CHAPTER IX

THE BRICKLAYER'S RELATION TO THE PUBLIC

IN the previous chapter we suggested that the public has an interest in the work of a bricklayer. This is not difficult to understand. The welfare and convenience of the people depend upon the character of building, and the safety of the people depends also upon the character of building. People doing the work of the world must be protected from the elements of the weather by buildings or civilization would be impossible.

By proper building, the safe employment of large numbers of people is made possible. By proper building the hazards of fire and suffering can be largely eliminated. By proper building better sanitation is assured, and the consequences of disease which grow out of insanitary construction of buildings can also be minimized. Again, by proper building the beauty of our cities can be improved, the streets of our towns can be made pleasant and beautiful to drive upon, and may even afford a place for a refreshing walk before or after a day's work.

It is for these reasons, therefore, that communities represented in the governments of municipalities, cities, and states make certain regulations respecting the work of a bricklayer. Laws affecting building construction are sometimes given in the form known as a "Code". A state building code, therefore, would contain the laws governing the construction, repair, and maintenance of buildings in a state, as, for example, the Building Code for

Wisconsin. Local laws, or city ordinances, pertaining to building are issued in the form of a city code, such as those of Chicago, Cleveland, New York, and Philadelphia. Some, of these orders are often included among fire regulations. Naturally, these building codes cover more than the work of the bricklayer. They embrace all matters of building construction, providing for fitting design, proper materials and quality of workmanship. These codes should be studied by the bricklayer for the city or state in which he lives, if he wishes to broaden his knowledge of the trade and learn something of the relation of his trade to other building trades.

What are some of the other trades treated in the building codes? The following are typical: plastering, plumbing and steam fitting, carpentry, painting and decorating, electrical, and sheet metal work, and so on. A bricklayer can make the work of other tradesmen difficult or easy. For example, if the bricklayer does not build the window jamb properly, it is more difficult for the carpenter to set the frame in its proper position and plumb. If the bricklayer in leaving the chase in the wall for pipes does not see that it is built plumb, the steamfitter and the plumber may have considerable difficulty in the installation of piping. In other words, the good mechanic is the one who thinks in terms of the finished job, and who, by his workmanship, coöperates with other workmen and leaves his job finished so that the mechanic who follows him will find his work pleasant to do, as it should be, and not made disagreeable by the other fellow's incompetence.

This vital relation between the bricklayer and other building mechanics should give a strong interest in building codes, but these codes should nevertheless be studied by the bricklayer for other reasons. They represent the

law of the land and affect him not only as a workman in providing methods of safety in construction, but as a citizen and a member of the community.

Since the Great War we have heard more about citizenship than we were previously accustomed to hear. Formal citizenship in America has been so easy to obtain by people from other lands, and in the new world so vast have been the opportunities for material gain that many of the privileges which we have enjoyed have been too much taken for granted. We have not appreciated sufficiently the toll which our forefathers paid for our priceless heritage. To be a citizen is a privilege for which in earlier times in all nations men have suffered and died, and the Great War, so far as the Allies were concerned, was after all a matter of fighting for the acknowledgment of the rights of citizens, and for the integrity of nations. These citizen rights, which include protection of life and of property, can be had only on condition the citizen performs the duties of citizenship. One cannot get something for nothing. Wherever there are rights there are duties, although the average citizen is more likely to put emphasis upon his rights than upon his duties.

Perhaps the greatest single element in good citizenship is personal integrity, or in other words, personal honor. Every man should have high regard for contract, and when he gives his word to do a certain thing he should be sure that he does it.

When a bricklayer obtains a job from an employer he enters into a contract. This contract may be expressed or implied; that is to say, it may be given by word of mouth or written, or it may be a contract by implication. If a bricklayer is hired to perform services and nothing is said about wages, the implication is that the bricklayer will be paid the prevailing wages, or the wages that are

customarily paid in the community where he works for the kind of work that he is doing, and he will also be governed by the other working conditions which are customary. This is the implied contract.

Another kind of contract is the apprenticeship contract, usually called "indenture". This agreement is entered into between the apprentice, his parent or guardian, and the employer. It is a contract in which the apprentice agrees to work faithfully for a given length of time for a certain consideration in wages, and for instruction and experience in trade practice to be given him by the employer or the employer's representative.

The wage contract is just as significant as many other contracts for both the workman and the employer, although frequently neither side recognizes this fact sufficiently. Written contracts have been recognized in law for hundreds of years and written contracts form the foundation of our political, industrial, and social life. Without respect for contract civilization is impossible. Without contract, and regard for contract, we could not have property, we could not have government, neither could we have proper social intercourse, nor any other of things which we enjoy. People who have no regard contract are usually the people who have no respect government. These people, if their conduct should permitted, would produce instead of a well-ordered iety, a nation of anarchy.

We have seen in our day how a government holding a powerful position in the world showed contempt for its agreements, and we have witnessed how that conduct made t necessary for other civilized nations to bring that government to account. Civilization demanded this, and the unfortunate thing is that before the wrong could be righted it brought about untold suffering and misery in the world.

The laws of the land which govern us in our relationship with one another in our everyday world are agreements which have been entered into by representatives of the people, the fulfillment of which is designed to bring the best results for the whole people. Therefore, those who violate these laws while living under their protection must of necessity be punished by the proper authorities and isolated in our reformatories and prisons. Since our civilization is based on contract and regard for law and order it is very easy to see that we could not carry on our business without it. In the building trade particularly, contracts form the foundation of business relations.

The bricklayer's employer is known and spoken of as the contractor. The contractor agrees to perform a certain quality and quantity of work for a given sum of money. In order to do this, therefore, he himself must make contracts with other men to assist him. The principal of these contracts is that one which he makes with his workmen — the wage contract. It is true that the average mechanic does not think of his work with the employer as a contract, and, on the other hand, it is not always that an employer thinks of his relation to his employees as a contract, and frequently both fail in their moral obligations. It is the significance and power of contract which has induced many trade unions to work for trade agreements. Instead of the wage contract of the individual workmen, they aim at a collective contract, sometimes called collective bargaining. In making these trade agreements they count upon the faith that the majority of people have in the obligations of contract, and when these agreements are made and kept the result is prosperity and industrial peace for both the employers and the workmen.

But while we speak of regard for contract we may examine the conditions which make contract possible. Contracts are not possible except where there is mutual confidence among men. In a community where a man's word is as good as his bond, it becomes possible for people to work in coöperation and to obtain the greatest amount of things desirable for the least amount of energy expended. Every man's work, as suggested in the preceding chapter, depends upon the work of some one else, and there must consequently be an ever-abiding confidence in the dealings of other men. This can be the case only when every man has regard for his word and for his agreement, even though that agreement may work temporarily to his disadvantage. When people lose confidence in one another a great waste in production ensues, for lack of confidence and fair dealing results in litigation, in strife and its consequence, all of which work to undermine the happiness and peace of a people.

Very often a mechanic gets a notion that these matters of mutual confidence and good-will are sentimental affairs, and should not be considered seriously, but if he will stop to think a little upon these things, he must of necessity come to the conclusion that where people do not have faith in one another, and fair dealing among men does not exist, there can be no such thing as contract, and no such thing as property. Where there is no mutual confidence among men, there no business exists at all. As a consequence, people do not wish to live in such a place, but move into communities where human rights of various kinds, including human rights in property, are properly respected. It cannot be too strongly urged, therefore, that the principles underlying the sacredness of contract are the paramount feature of citizenship in our modern society.

Naturally, a citizen wishing to be fair with his fellow men will desire to become conversant with the "rules of the game", in other words, the laws of the land. He should, therefore, learn something about the methods by which these rules are established, that is, the work of the legislatures and of the courts, and the way in which these laws are administered. No man grossly ignorant on such matters can prove a very great benefit to the people among whom he lives and works.

SUMMARY

1. The public has a vital interest in the work of a bricklayer. The community safety, welfare, and convenience depend upon the character of building.

2. Building codes show the public concern with building construction. A knowledge of building codes is desirable for a bricklayer.

3. Each workman engaged in the construction of the building should perform his part so that the workman that follows him can do his best work, and finish a good job.

4. One can't get something for nothing. Citizens' rights imply citizens' duties. The chief duty of a citizen is regard for law and order, and respect for the sacredness of contract.

5. The basis of all prosperity is mutual confidence among men. If people do not keep faith, business is impossible, and anarchy soon results. Regard for one's word, which brings confidence, is not only a duty but an absolute necessity for civilized society.

QUESTIONS FOR STUDY AND DISCUSSION

1. What relation is there between the building trade and the public welfare?

2. Why do cities and states issue and enforce laws and rules for the construction of buildings?

3. Show how bricklaying may prove a public danger.

4. Give an example of an implied contract, a written contract.

5. What is the relation of contract to the well-being of the whole public?

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CHAPTER X

TRADE ORGANIZATIONS

Trade associations. This industrial era in which we now live is one of organization. The extent to which organization is necessary has been amply demonstrated by the experiences of the Great World War. Our country could never have been an effective fighting machine if strong leaders had not done some masterly strokes in organization work: Our draft law, which involved the registration of millions and millions of citizens and the calling into the army of millions of soldiers, making necessary their training, their feeding, their clothing, and their transportation, could not have been enforced without efficient organization.

Organization means that men work together under definite rules and under definite leadership. It means collective action. In all walks of life men are usually drawn together by common interests. Ministers of the gospel have their ministerial associations. Lawyers have their bar associations. Manufacturers have their manufacturers' associations. Building contractors have their building contractors' associations. And workmen have their trade unions. It has been proved by experience, as we have tried to show in Chapter VIII, that the common good means in the end greater individual good for the majority of the people. Men have found that by getting together and promoting the general welfare of all, they will, in the end, gain more for themselves and make the world a better place in which to live.

There are two principles which underlie trade and industrial organizations. One is the principle of coöperation or mutual helpfulness, the other is that of strict competition or mutual destruction. The only justification of any organization, however, whether social, economic, or political, is the desire and purpose of coöperation.

Organizations whose purposes are destructive cannot long be tolerated by any community. Building contractors by coöperation may determine upon a fair method of figuring costs of construction and of making general charges which the public must pay for their buildings. By coöperation they may help one another in business, and in the end all profit thereby. A good example of coöperation is afforded by building contractors who have organized mutual protective associations, such as that which exists in the city of Milwaukee, Wisconsin, where the contractors jointly insure themselves against losses due to industrial accidents in their trade. Each pays a little into a general fund and the total yields a sum of money sufficient to pay workmen's compensation claims as they arise. Without coöperation, should an injured workman succeed in a claim for compensation involving a large sum, the individual contractor might be put completely out of business.

Corresponding to the employers' associations, organizations among workmen known as trade unions have enabled the men through collective action to obtain conditions which individually they would not be in a position to gain. By getting together they can agree upon certain conditions upon which they will work, with a view to getting fair conditions of work and shorter hours of labor.

The journeymen, moreover, have likewise organized themselves into benevolent societies and give their members sick benefits and death benefits. The national

organization among the journeymen is known as the Bricklayers', Masons' and Plasterers' International Union of America. It can be seen from the title, therefore, that not only have the bricklayers combined in an organization for mutual helpfulness, but that even other crafts related to bricklaying have all coöperated for the common good. Trade organization is accepted by all fair-minded men and women to-day to be not only a necessity, but a possibility for much good in our industrial life. Because trades are organized it does not mean that there must necessarily be strife in the trade. It should mean greater coöperation. The growing tendency toward trade agreements in the building trades demonstrates the possibilities of trade coöperation.

Most cities have what are called Builders' Exchanges or Builders' Clubs. These are organizations of employers. In some cases there are state associations, but there does not seem to be such a degree of solidarity among the building contractors as is found among the journeymen of the trade.

The principal bricklayers' organization, the Bricklayers' Masons', and Plasterers' International Union of America, came into being in the year 1865. It was preceded by local organizations, some dating back many years. At the national convention there were represented bricklayers from Washington, Baltimore, and Philadelphia, and the organization was effected in the city of Baltimore. The membership reported at this convention was 1912. In the year 1881 the organization admitted representation from Canada and became known as the Bricklayers', Masons' and Plasterers' International Union of America. In 1880 the adverse conditions of industry brought the activity of the organization to a low ebb, but it revived later and has continued to grow until to-day it has a

membership of approximately 90,000, and embraces bricklayers all over the United States and Canada. Its headquarters are in Indianapolis, Indiana.

It is an organization which is on record as opposed to strikes, except as a last resort. It is an organization which believes first, last, and all the time in coöperation. It publishes a journal called, *The Bricklayer, Mason and Plasterer.* It holds conventions biennially in different sections of the United States. In many respects this organization for many years was what is called "independent", as it was not directly tied up with other trade organizations. Recently it has definitely aligned itself with the American Federation of Labor, and no one can question the influence and power that this association has in the American labor movement.

The International Bricklayers' Union is represented in practically all cities by locals which are known by numbers. For example, the Bricklayers' Union in Madison, Wisconsin, is known as "Union No. 13, Wisconsin", in Cleveland, Ohio, as "Union No. 5, Ohio".

From what has been said above, it is easy to understand that all mechanics in the trade should strive to make themselves intelligent and skilled so that in case they become affiliated with the trade union or any other trade organization they may be intelligent members and able to participate in the business features of the organization, and, moreover, each one of the workmen should be as one "who needs not to be ashamed", so that the trade society to which he belongs may be proud of his membership.

Trade agreements. In order that the contractors and the bricklayers may work under conditions of coöperation, the practice of writing trade agreements has come into prevalent use. In many cases some of the larger con-

tractors in the United States have agreements with the headquarters of the International Bricklayers' organization so that wherever they go they may be working under a standard agreement, and not be subject to the changes or the differences of rules which are in effect in different cities and states. Large contractors who are estimating on jobs all over the country must have some definite knowledge of the conditions under which they can employ their men, and not be subject to interference by local organizations. This is a special arrangement. Most of the contractors, however, must make their working arrangements with the trade unions of the city in which the building takes place. These agreements work out in the following way.

The bricklayers' union takes the initiative and makes a request for certain conditions of work and a minimum rate of wages. These demands are presented to the contractors' association to be subsequently considered by the association. If the contractors are willing to accept the conditions or grant the request, an agreement is effected between the business agent who represents the union and the secretary of the contractors' association for the contractors. In other cases where agreements are not so easily obtained arbitration boards are formed in which the union has equal representation with the contractors' association, and they meet in committee to thrash out the differences and to arrive at a working basis.

In the building trade conditions have shown that it is folly to resort to violence, and that the best conditions of the trade are obtained by intelligent and peaceful methods of procedure.

The bricklayer has, perhaps, better working conditions than the workman in any other of the building trades. Let us see how this has happened.

Bricklayers, for the most part, hold what may be called the "strategic" position in the building trades, which has given them some advantage in bargaining power as compared with some other craftsmen in related trades. The bricklayer, if a brick building is to be erected, is the man who must of necessity be obtained to put up the job, and if he is not obtained the whole building operations must stand back. On the other hand, let the walls once be erected and building operations will not stop because one trade may have difficulty in reaching an agreement. For instance, the plumber may be dissatisfied with the terms of the contract, but the carpenters may do considerable work and the plasterer may be able to go ahead, and perhaps the employer can make a good deal of headway before he is compelled to meet the conditions imposed upon him by the plumber. But on the other hand, the bricklayer is the first man with whom the contractor must settle if he is to erect the building with bricks, and many times a bricklayer is given favors and better conditions so as to get things started, and afterwards perhaps some other trade will have to pay the price. A good illustration of this occurred in Cleveland, Ohio, some years ago when the carpenters were on a strike. Since the carpenters were not on the job, the bricklayers actually undertook to set the window frames so that they could go ahead with their work. This was quite possible for the bricklayers to do. On the other hand, had the bricklayer been dissatisfied and been on a strike, it would have been impossible for the carpenters to erect the walls, so the carpenters were at a disadvantage compared to the bricklayers. This fact the bricklayers should not lose sight of, because it is quite possible that they may have received better working conditions in some instances at the expense of other men in other branches of the building trade.

A bricklayer should never forget that if an organization guarantees to him certain rights, at the same time it imposes upon him certain obligations. Where one has rights there must be duties. A man who is a member of a trade union has not only a solemn obligation to his fellow workmen, but has a more significant obligation to the public. His attitude in the organization, or his position in an industrial dispute, may affect very materially the welfare of not only the men in his trade but the whole community in which he lives. When men resort to strikes, which is in reality simply a determination to refuse to render the economic service which they are supposed to render for their living, it is a matter of serious consequence to the public. Any withholding of service on the part of an individual, or the withholding of services on the part of his organization, known as a strike, should be the result of thorough consideration from the standpoint of not only the individual's future welfare and prosperity, but equally that of the community of which he is a part. In other words, every intelligent mechanic must seek to promote a square deal both with reference to his employer, and his organization.

SUMMARY

1. The building trade has its organizations for both employers and employees.

2. Organization is a great agency for coöperative activity, shown by organizations of government, by professional men, employers, and workmen.

3. The Bricklayers', Masons' and Plasterers' International Union of America publishes a monthly paper called the *Bricklayer, Mason and Plasterer* and holds conventions biennially.

4. Members of organizations for mutual benefit must not lose sight of the public, which is the silent partner in all lawful organization activity.

QUESTIONS FOR STUDY AND DISCUSSION

1. Give examples of organization work which has benefited your community. Can you name an organization which has worked against public benefit?

2. People speak often of their "rights", but little of "duties". Can there be rights without corresponding duties? Give examples of both rights and duties.

3. Have you had such a thing in your community as collective bargaining? Is there a bricklayers' organization in your community? What do you know about it?

4. What is meant by "strategic position"? Do you see an opportunity for an unfair attitude on the part of bricklayers toward other craftsmen?

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CHAPTER XI

APPRENTICESHIP IN THE TRADE

IN the Middle Ages a bricklayer's apprentice was obliged to serve a term of seven years. He lived in the house of his employer and was supposed to do work around the house after working hours. He received no pay and it was usually required of his parents that they pay over a certain sum of money to the employer to take him as an apprentice. This was called paying a "premium", and in some parts of Europe to-day premiums are paid to employers to take apprentices to teach them the trade. In those days the trade guild, which was an organization made up of both journeymen and masters, supervised the apprentice. It was necessary, however, for the apprentice to have an apprentice indenture, a good example of which is contained below. This indenture is one for the trade of a broadweaver, written in the year 1708, but similar forms of apprenticeship agreement were used for all the trades.

"This indenture made the sixteenth day of January in the Seventh year of the reign of our Sovereign Lady Anne of Great Britain, France, and Ireland, Queen Defender of the faith ex A.D. 1708. Between William Selman of the parish of Corsham in the County of Wiltes, Husbandman, and Richard Selman son of the said William Selman of the one party and Thomas Stokes holder of the parish of Gorsham aforesaid Broadweaver of the other party. Witnesseth that the said Richard Selman of his own voluntary will and with the consent of his said father William Selman hath put himself an apprentice unto the said Thomas Stokes and with him hath covenanted to dwell as

his apprentice from the day of the date hereof until the full end and term of seven years fully, to be complete and ended, during all which time the said Richard Selman shall well and faithfully serve him, the said Thomas Stokes his master, his secrets lawfully to be kept, shall keep his commandments, lawfully and honestly shall do and execute, hurt unto his said master he shall not do nor consent to be done, taverns or alehouses he shall not haunt, dice, cards or any other unlawful games he shall not use during such time as he shall stay in his master's service, matrimony with any woman he shall not contract, or espouse himself during the said term of seven years, the goods of his said Master he shall not waste nor to any man lend without his master's license, from his master's house or business he shall not absent himself by night or by day without his master's leave, but as a true and faithful servant shall honestly behave himself towards his said master and all his, both in words and deeds, and the said Thomas Stokes doth for himself his Executors and Administrators promise to Covenant to and with the said William Selman and Richard Selman his apprentice to teach or cause the said Richard Selman to be taught and instructed in the trade of Art science or occupation of a Broadweaver after the best manner that he can, or may with moderate correction, finding and allowing unto his said Servant meat drink apparell washing lodging and all other things whatsoever fitting for an apprentice of that trade during the said terms of seven years And to give unto his said apprentice at the end of the said term double apparell (towit) one suit for holy days and one for working days. In witness whereof the said parties to these present Indentures interchangeably have set their hands and seals the day and year first above written Sealed and Delivered in the presence of

(Signature).[1]

This agreement shows to what extent apprenticeship had control over all the actions of the youth. The apprenticeship relation, while it had many hardships, as long periods of learning must have, nevertheless had many desirable features. The apprentice was in close contact with his master. He learned the theory along with the

[1] This form has been slightly changed in some word spelling, some additions in punctuation have been made, and a few superfluous words have been omitted in order to make the indenture read more clearly. Taken from *English Apprenticeship and Child Labour* — Dunlop & Denman, page 352.

practice every day; in fact, he scarcely knew how to separate theory from practice. In those days a bricklayer had to perform more operations in the building process than he does to-day, for, as we pointed out in Chapter VIII, there has been much division and subdivision of labor during the last few centuries.

To-day the boy who is an apprentice no longer lives in the house with his employer. He is what is called the "outdoor apprentice"; instead of receiving his board and room he gets pay. He has little opportunity to get theory of his trade while working, and, accordingly, many efforts are being made to provide evening schools and dull season schools, correspondence courses, and the like, to enable him to gain that theoretical grounding which is so difficult to obtain in modern practice.

In America we have depended so much upon European skill that we have not given the attention to apprenticeship that we should. However, in recent years it has not been so easy to obtain mechanics from Europe, and this condition will be more pronounced as time goes on. It becomes necessary, therefore, for employers to consider apprenticeship in the trade, and it becomes desirable for boys to understand the advantages which come from learning this ancient trade. Apprenticeship in the bricklaying trade has been kept alive by the organizations of journeymen. The journeymen's unions have established rules according to their local conditions to control the entrance of boys into their trade, and have sought to foster a good system of apprenticeship. They have not, however, always succeeded, although they have made steps in the right direction. At the present time, the tendency is for the local unions to give up jurisdiction in the apprenticeship matter in order that the conditions of learning the trade may be standardized throughout the

state or nation, so far as it is possible. Consequently, the Bricklayers', Masons' and Plasterers' International Union of America has recommended certain standards which they endeavor to have put in practice by the local unions in the different communities throughout the nation.

The standard term of apprenticeship is now four years. This means four building seasons. Very often in a climate like that of North America a considerable portion of the year may be rendered undesirable for building by weather conditions and as a result the bricklayer may have a long idle period. Since, therefore, approximately four years are necessary to learn this trade the question arises whether this need is met when the apprentice serves during a period of four years of short building seasons, say of no more than six months each. As a solution to this problem a minimum number of months for every year has been determined upon in some places. That is to say, if this number of months is not worked during one year, it may extend the term of the boy's apprenticeship. A good example of this is seen in the state of Wisconsin where the apprenticeship arrangement provides that a boy shall serve an apprenticeship of four years, each year to consist of not less than nine months. In other words, if the boy works fewer than nine months in one year his period of apprenticeship must be extended to make up in all thirty-six months. If, however, in any one year, or if during the term of four years he works more than would make nine months each year, or thirty-six months, he acquires no additional credit for that time, since the thirty-six months is the minimum required and not the maximum.

The wages of an apprentice range from about one-third to one-fifth of that of the journeymen during the earlier

years. Toward the end of his apprenticeship he may get a wage which approximates very closely to that of the journeyman.

The apprentice usually puts in the first few months at the trade in working around the mortar box and brick piles, helping with scaffolding, winding up lines, and a great number of special jobs, the like of which a beginner must always perform in any trade. Sometimes this period of so-called "handy work" is too long, and it becomes necessary in an apprenticeship indenture to specify the limits of such a period.

The kind of work suggested above requires considerable strength and ability; consequently, it is not desirable for boys under sixteen years of age to enter this occupation. It is not surprising, therefore, that the sixteenth year is accepted as the lowest age for entrance to the trade. Moreover, some state laws prohibit boys working around buildings under that age.

When the boy begins to use the trowel he usually starts in backing up behind face work, in order to learn the method of using the trowel. He is very often put to the job of filling up putlog holes, and pointing up work which may have been performed by a journeyman.

It is necessary for an apprentice on a modern building to "keep his eyes open", to put in a good deal of time practicing operations with his trowel, the use of the plumb rule, and similar phases of work in his trade. He is usually expected to stay and clean up a little time after the other men quit. He is expected to wind up the lines, help the foreman to cover up the walls and to do such things as may be necessary. He should take an interest in his work, he should remember that his apprenticeship agreement is with the employer, that his interest is the same as that of his employer. Only by interest shown

in his work can he succeed. He must, however, keep on good terms with the journeymen and show himself willing to be accommodating, and as a result the journeymen will take an interest in him and he will soon learn to be proficient in the various phases of his trade.

In some cities, such as Chicago and Cleveland, provision is made so that the apprentice can take up the theoretical work in his trade, such as plan reading, elements in calculation, etc., during the winter months. With vocational schools springing up all over the country these opportunities are going to be greater for apprentices than ever before. What is being done along this line can be judged by the state of Wisconsin, which has an apprenticeship law that provides for the supervision of apprentices in all the trades, and therefore, the apprenticeship in the building trades is a part of the scheme. As a result every bricklayer apprentice in the state of Wisconsin must sign an indenture like the one opposite.

Exhibit " A " refers to the detail which is agreed upon by the unions and the employers, which expresses an understanding of the conditions of apprenticeship in the trade. In some states it may differ slightly from that of other states. In the state referred to a diploma is given to the graduating apprentice at the conclusion of the apprenticeship, which is issued by the state and countersigned by the employer. However, these diplomas are not given to apprentices who have not fulfilled their requirements, part of which is the attending of classes instituted for trade science, drawing, and the like. In some parts of the country a diploma or a certificate is given to the young journeyman, which is furnished by the employer.

The writer wishes to say that it is his belief, based upon experience and observation, that apprenticeship will be

APPRENTICE INDENTURE

This Indenture, Made in triplicate this .... day of ...., 19... between .... hereafter called the first party, and .... a minor born .... , of .... ,
Date of Birth Street and Number

..................., and ....
City and State Name of Parent or Guardian

hereafter called the second parties:

Witnesseth, That the first party agrees to take the said minor into its employ and service as an apprentice to teach him the trade of ...., as per Exhibit A.

That the second parties agree that the said minor shall diligently and faithfully work for and serve the said first party during the full term of apprenticeship.

The apprenticeship shall begin on the ....day of ...., 19 , and shall be for a period of .... years. The length of year, the compensation for the term of apprenticeship, and the processes, methods or plans to be taught shall be as per Exhibit A.

It is mutually agreed that until the minor's eighteenth birthday the total number of hours work in any one week shall not exceed fifty-five (55) and that at least five (5) of such hours or its equivalent shall be devoted by said minor to school instruction.

(This clause shall not be construed to prevent school instruction after the minor's eighteenth birthday if both parties agree to the continuation of the same.)

At the completion of the apprenticeship the said minor shall receive a certificate stating the terms of his indenture.

In Witness Whereof, The parties have caused this indenture to be signed as required by Law.

..................(Seal) ....
Apprentice. *Name of Firm or Corporation.*

..................(Seal) By..........................
Parent or Guardian.

..................(Seal) ....(Seal)

more successful where supervised by some third party, or supervised under joint control representing both the interests of the employer and the employee. However, where public authority cannot be invoked to supervise apprenticeship, and where employers and employees do not agree on a joint supervision, there is only one thing that can possibly result and that is for the journeymen themselves to take into consideration the welfare of the apprentices, who are the men sooner or later to make up their ranks.

OUTLINE OF TRADE REQUIREMENTS FOR JOURNEYMANSHIP

In order to be a reasonably competent and intelligent mechanic the bricklayer should have an understanding of what is outlined below.

1. The Varieties, Properties, and Manufacture of Material

The apprentice should learn something of the chief varieties of the following building materials manufactured and used in the United States and should give attention particularly to local practice. Knowledge should be had of what makes some varieties of material differ from others, and what advantages certain kinds have over others with reference to particular uses.

(*a*) Brick
(*b*) Tile
(*c*) Terra cotta
(*d*) Stone
(*e*) Lime
(*f*) Cement
(*g*) Sand and gravel
(*h*) Mortar
(*i*) Mortar coloring
(*j*) Concrete

2. Meaning of Trade Terms

The meaning of such trade terms as are found to designate tools, bonds, materials, and processes as are used in the building. (See Glossary.)

3. Bonds of Brickwork

The apprentice should learn to sketch on paper in order to show the way in which bricks are laid to make bonds named below, and should, of course, also learn to make these by actual practice.

(a) Header
(b) Stretcher
(c) Closers
  King
  Queen
  Quarter
(d) Old English bond
(e) English Cross bond
(f) English Garden bond
(g) Dutch bond
(h) Flemish bond
(i) Single Flemish
(j) Double Flemish
(k) Flemish Garden bond
(l) American bond
(m) Raking bond
  Diagonal
  Herringbone
(n) Rowlock
(o) Soldier course
(p) Bull-header
(q) Bull-stretcher
(r) Panel

4. Joints in Brickwork

The following joints of brickwork should be recognized on sight, and a bricklayer should be able to show them by sketches with a pencil, and should also be able to do them neatly on actual brickwork under construction.

(a) Flat or flush joint
(b) Flat joint jointed
(c) Struck joint
(d) Weather joint
(e) Tooled joint
(f) Recessed joint-raked
(g) Mason's joint

5. Arches in Brickwork Construction

The following list of arches should be mastered and recognized readily and practiced by apprentices upon the job when possible and also in the schools, where there should be provided facilities and instruction to carry out actual work.

(a) Semicircular
(b) Common or jack arch
(c) Gauged or jack arch
(d) Pointed or Gothic
(e) Flat or camber
(f) Elliptical arches
(g) Three centered
(h) Four centered
(i) Relieving arch

6. Concrete

A journeyman must know the common properties of material entering into concrete. Although a bricklayer should know how to mix concrete, yet his scope in this direction is very limited. Concreting is unskilled work for the most part, and usually performed before the bricklayer gets on the job.

(*a*) Portland cement
(*b*) Stone
(*c*) Sand
(*d*) Water
(*e*) Proportions in mixture
(*f*) Forms

7. Blue Prints

A bricklayer should know how to make simple drawings, to sketch bonds and simple plans, and should know what the drawing indicates so that he can work from it. A good bricklayer does not need to be a draftsman, but should know:

(*a*) General use of drawing instruments.
(*b*) Drawings of bonds, their plan and elevation.
(*c*) Reading of plans, elevations, and working drawings.
(*d*) Sectional details.

8. Trade Science

A practical knowledge of the characteristics of elementary building material should be acquired. There is no need for exhaustive analysis, but only an everyday acquaintance with the peculiar chemical action of these materials, which is caused by weather conditions, and by preparation for use. This will enable the workman better to understand the uses to which the materials can be put, and the way to utilize them for the best results in building.

(*a*) Wood
(*b*) Stone
(*c*) Brick
(*d*) Limes
(*e*) Cements
(*f*) The test for purity of materials
(*g*) The effects of weather: freezing, expansion, etc.

9. Measuring and Quantity Surveying

A bricklayer should have practice with and know how to use a builder's tape; also to handle properly the transit level. Particular attention should be given to the use of the hand level and the

plumb bob. A knowledge should be had of ordinary excavating, laying out lots, measuring heights, and lining up walls, so that the mechanic may be able to set out his own work, and if need be, prepare himself to act in the capacity of foreman.

(a) Practice with builder's tape
(b) Level
(c) Excavations
(d) Measuring heights
(e) Lining up walls
(f) Practice with hand level and plumb bob

10. The Study of the Apprenticeship Contract and the Elements in the Law of Contract

A mechanic should know something about the history and development of bricklaying; the relation of the trade to other industries forming a groundwork upon which to gain knowledge of modern industrial conditions.

The subjects of English, Safety, and Hygiene can be studied in connection with the Building Code, with which all modern bricklayers should be familiar.

(a) Brief history of the trade

(b) Relation of the trade to other industries

(c) Citizenship
    Contract
    Obligations of citizenship
    Meaning of government

(d) Building Code
    Nature
    Purpose
    Authority
    Chief content

11. Scaffolding

A bricklayer is often called upon to build his own scaffold and in any event should know something of scaffold building, in order to know when the scaffold is safe to work upon. He should be acquainted with the different varieties of scaffolding, and know the good and objectional features of each.

(a) Varieties of scaffolding
(b) Methods of erection
(c) Safety (See Building Codes.)

12. Tools

Considerable attention should be given to bricklaying tools, their uses, and methods of keeping them in trim. A good mechanic usually has good tools, and no apprentice should expect to graduate into journeymanship without a kit containing a reasonable number of bricklayer's tools, which he should know how to use and to keep in good condition. (See Chapter III.)

13. Practical Tests

A graduating apprentice should be able to:

(*a*) Spread an even bed of mortar for four or more bricks with a single trowel of mortar.

(*b*) Build a corner "scaffold high" in a workmanlike manner, plumb and level without bricks being disturbed from their original bed, and to construct it in a reasonable period of time.

(*c*) Turn any ordinary brick arch in a workmanlike manner.

(*d*) Build workmanlike fireplaces and flues.

(*e*) Lay bricks true to the line and to strike joints in a workmanlike manner.

(*f*) Erect a pilaster level and plumb in a reasonable length of time.

(*g*) Be prepared to "hold his own" on the wall with other bricklayers.

14. Sources of Information

(*a*) Public libraries

(*b*) References listed in this text

(*c*) Personal observation of actual construction and interviews with men engaged in building

GLOSSARY

Absorbent — capable of taking in water or moisture.

Abutment — that part at the end of any pier or wall which supports the arch to prevent the arches from spreading, — to resist the lateral thrust.

Accurately — with a high degree of exactness; according to true measurements.

Agriculture — the science or art of cultivating the ground; farming, etc.

Air space — a cavity, or space, in the wall, or between building materials.

Alumina — a mineral contained in the clay used for brickmaking.

American bond — that bond in which a header course occurs every seventh course.

Apprenticeship — the period, and also the system, of learning to become a skilled mechanic by working in the trade under direction.

Apprenticeship indenture — a written agreement between the employer and the apprentice concerning the terms and conditions of learning a trade.

Arch — the brickwork built to support its own weight and the weight of the wall above, which is constructed over windows, doors, and other openings.

Architect — a person especially skilled in the art of building. Usually one who makes a profession of designing and supervising the construction of buildings.

Architecture — art or science of building design, giving certain rules and principles for correct proportions, stability, and usefulness of structures.

Artificial — that which is done by artifice, as opposed to what is natural or produced by nature.

Artistic — approaching the standards established by students of art; beautiful; in harmony.

Atmospheric changes — variations in the conditions of the air.

Babylon — the capital city of the ancient empire of Babylonia.

Babylonia — an ancient empire of the Euphrates valley which 2250 years before Christ was the center of the world's commerce and of the arts and sciences.

Backing — the rough brickwork build behind face work.

Backing up — laying the inside portion of the wall after the facing of the wall has been built header high.

Balanced — made symmetrical, and in correct proportion.

Basement — the lower part of a house or building, usually below the ground.

Bat — a piece of a whole brick, usually a half or three-quarters the length of a whole brick.

Batter — the slope backwards of the face of the wall, opposite to "overhang".

Beam — a piece of timber, iron, or steel, or other material used to support heavy flooring, or the weight over an opening which is supported by walls, columns, or posts at either end.

Bedford limestone — a certain formation of limestone rock, which is called Bedford because it was first found at the city of Bedford, Ohio.

Benevolent societies — organization of individuals who are banded together for the purpose of relieving distress or doing good.

Biennially — every second year.

Bisect — to divide in two equal parts.

Brick — a standard unit of building material, made by fashioning clay into rectangular blocks, and subjecting them to burning in a kiln.

Brick veneer — the outside facing of brickwork used to cover a wall built of other material; usually refers to brick walls inclosing a frame building.

Brickwork — masses of wall built out of bricks laid in mortar.

Builder's tape — a long, narrow, flat steel band with feet and inches marked upon it, which will easily wind up on a reel so as to go into one's pocket.

Bulging — swelling.

Bull-header — a brick laid on its edge showing only the end on the face of the wall.

Bull-stretcher — a brick laid on edge so as to show on the face the broad side of the brick.

Bungalow — a one story or a story and a half, small house, or residence.

Buttering — spreading mortar on the brick before it is laid.

Cavity wall — a wall which has an air space built in, usually back of the outside four inches.

Cement — a burned mixture of clay and limestone pulverized for making mortar, or concrete.

Center — the temporary support to hold up the arch while it is being built. Also means to find the center point for the curve of a segment in an arch.

Center pieces — the temporary support used to hold up the arch while it is being constructed, and until it is set.

Century — a period of one hundred years.

Characteristics — distinguishing features.

Chase — a channel in the brickwork to receive piping.

Chemical — a substance obtained by a chemical process.

Chemical action — that action of substances that results from bringing certain elements in contact with other elements.

Chimney — a shaft built to carry off smoke.

Chimney lining — that fire clay, or terra cotta material, made to be built inside of a chimney.

Classification — a class, or kind, a grouping of things according to similar characteristics.

Code (building) — a set of laws or regulations governing the location, materials, and workmanship in the construction of buildings.

Color scheme — the plan of color harmony.

Column — a round pillar designed to support portions of a building, or to give such an appearance for ornamental purposes.

Commercial or business building — that building adapted for the purposes of carrying on trade and commerce.

Common American bond — that bond in which every seventh course is a heading course.

Common brickwork — wall built out of the ordinary and cheaper classes of brick, where appearance is not an important consideration.

Compasses — the instruments for making circles or parts of circles used in striking an arch.

Competent — capable, efficient, thoroughly skilled.

Consistency of mortar — the character of the "make up" of mortars

Construction — the act of putting parts together, or building.

Contract — a binding agreement between two or more parties; also a system of law which has grown up with reference to the enforcement of the contract in the courts. The contract is one of the fundamental institutions of the social order.

Contractor — one who undertakes to perform a certain amount of work of a definite character for a specific sum of money.

Convention — a gathering together of representatives, or delegates.

Coping — the covering for the exposed top of a wall, which is laid on to shed tne water, and to protect the wall against the weather.

Corbeling — successive courses of bricks projected from the surface.

Craft — a skilled occupation, or trade.

Craft guilds — organizations of workmen in a particular skilled occupation which comprised both masters and journeymen, and which thrived particularly in the Middle Ages.

Crane — an apparatus for lifting and placing heavy material. It is worked on the principles of the lever, the pulley, and the wheel and axle, or may be worked by hand, by horse-power, by steam, or by electrical power.

Criterion — an example from which to form a correct judgment.

Cross hatching — shading with lines that cross one another obliquely.

Cross joint — the joint between the two ends of the brick.

Crowding the line — laying the line bricks in such a way as to prevent the line or string from being clear of the face of the brickwork. In other words, building with a tendency to make the wall overhang.

Crown — the highest point in the arch, on the extrados.

Cubic — pertaining to three dimensions, *i.e.*, length, width, and depth.

Cubic foot — a foot measurement in three dimensions measuring a foot long, a foot wide, and a foot deep.

Damper — a door or trap for the admission and shutting off of currents of air, as in the throat of a chimney, stove, boiler, etc.

Damp-proof — capable of resisting damp.

Demarcation, line of — line of separation; the division point.

Describe an arc — to draw a part of a circle, or a small segement of a circle with the compasses.

Design — the consciously planned scheme for the accomplishment of certain purposes and effects in a building. The character of the plan, elevation, and details of an edifice.

Details — the individual parts of a structure. Details of drawing show how the different parts and sections of the building are to be done.

Diagonal bond — a form of raking bond where the bricks are laid in an oblique direction in the center of a thick wall, or in paving.

Diagram — a graphical representation showing the arrangement of parts; a chart, or plan.

Discharging or relieving arch — that arch which is built over a lintel to relieve the pressure of the wall above.

Disintegration — process of breaking apart, or into pieces.

Division of labor — the process of dividing a job which was one person's work into different parts so that one person may work on one part and another on another, and so on.

Draftsman — a person whose business it is to make drawings, such as plans, elevations, working drawings, etc.

Durability — the capacity to stand long and hard use.

Dutch arch — a flat arch whose voussoirs are laid parallel to the skewback on each side of the center.

Dutch bond — the arrangement of bricks forming a modification of Old English bond, made by introducing a header as the second brick in every alternate stretching course, with a three-quarter brick beginning the other stretching courses.

Dwelling — a habitable cottage, perhaps a more poetic term for a house.

Economic — pertaining to that sphere of life and human activity by means of which man creates wealth and uses it; pertaining to what has been termed the " bread and butter " science.

Economical — opposite to wasteful; pertaining to the practice of using no more of material or effort than is necessary to accomplish a given purpose.

Edifice — another word for building, structure, etc.

Effectiveness — distinguished appearance.

Efflorescence — the formation of a salt-like powder on the face of the wall.

Egyptians — natives of Egypt, who live mainly along the banks of the river Nile, and whose civilization was in a high state of development 5000 years before the birth of Christ.

Elevation — the upstanding part of a building. On a drawing it is that part which gives details of the upright parts of the proposed building.

Elliptical arch — the technical definition of an elliptical arch is too difficult for the purposes of this book. However, it may be said to be a semicircular arch whose crown is depressed, showing its span correspondingly lengthened, to approximate more nearly the appearance of a segmental arch.

Encaustic tile — tile prepared by burning in certain preparations for particular effects.

Engineer (building) — one who follows the profession of designing and laying out construction, particularly skyscrapers, bridges, railways, and the like.

Engineering (structural) — the designing and erection of large modern buildings.

English bond — usually called Old English bond, the bond which is made by alternate courses of stretchers and headers, with a 2-inch piece or closer next to the corner header.

English cross bond — a variation of English bond made by putting one header next to the corner stretcher on alternate stretching courses.

Estimating — the process of trying to calculate the cost of a job in advance.

Excavation — that part of the earth that is dug out to receive the foundation, or to make room for some part of the building.

Exchange — the process of rendering service for service, or selling goods for money, and money for goods, or of trading goods for goods.

Exterior — that portion which is situated on the outside.

Extrados — the upper and exterior line or curve of the arch.

Face — the front or exposed surface of the wall, or brick.

Fat mortar — sticky mortar which usually has an insufficient amount of sand.

Filling in — the process of building in the center of the wall between the face and back.

Fire clay — a grade of clay that can stand a terrific amount of heat without softening or burning up, therefore used for fire bricks.

Flange — the projecting edge such as the edge of an angle iron or the top and bottom edges of an I beam.

Flat arch — is that arch whose top and bottom are flat, or practically so. It involves the same principles of stress and strain as a segmental arch, but has the voussoir extended up and down to reach the level lines.

Flaws — defects, *e.g.*, bad places in bricks and plaster.

Flemish bond — that arrangement of bricks made by alternating headers and stretchers in each course. The position of each header is in the center of the stretcher above and below.

Flemish bond (double) — that arrangement of the bricks which gives Flemish bond on both sides of the wall.

Flemish garden bond — bricks laid so that each course has a header to every three or four stretchers.

Flue — the hollow shaft in a chimney through which air and smoke pass.

Flushed — filled up to the surface.

Footing — the lower part of the foundation wall which rests upon the earth; the base or "foot" of the wall.

Foundation — the supporting part of the building or walls, usually below the ground level.

Fracture — a break or split.

Frame high — the height of the top of the window or door frames; the level at which the lintel or arch is to be laid.

Furring — a lining or covering to make a level surface.

Gauge — to gauge is to measure for a particular purpose. Some tools for particular measurement may be termed a gauge, as, for example, a "gauge stick" with courses of brick marked thereon.

Gingerbread work — work with cheap decorations without any respect to their fitness.

Glazed tile — tile which is finished with a glass-like surface.

Glossary — a collection of notes explaining words and phrases of the book.

Gothic arch — a pointed arch made up of two segments whose points meet at the crown.

Gravel — small, more or less rounded, stones and pebbles mixed with coarse sand.

Greeks — the natives of Greece, a country in Europe.

Ground floor — the floor of the building on, or slightly above, the level of the ground.

Grout — a thin liquid form of mortar which can be poured into thin joints and cracks.

Gutter — a hollow or channei made to carry off superfluous water; also, for a house, to carry off the rain water.

Harmonize — to agree with the surroundings.

Header — bricks that are laid so that the ends show on the face of the wall.

Header high — an expression indicating that the wall has been built high enough with stretching courses, and therefore ready for the heading course.

Heading bond — that bond where all the bricks are laid, as headers, with the ends to the face of the wall.

Height — the measure upward on face of wall, measurements in perpendicular.

Heritage — that which is ours by right of birth; an inheritance.

Herringbone bond — bricks laid in an angular or zigzag fashion, resembling the bone in a herring.

Homogeneous — all of the same kind; whole formed out of various parts.

Horse — a square frame made to support scaffold boards, usually five feet square. To be distinguished from the "trestle horse".

Hygiene — the science of the preservation of health.

Imperviousness — the quality of resisting moisture.

Industrial life — that sphere of human activity which concerns itself with industry.

Industrial system — the method of carrying on industry; as, for example, the factory system, the handicraft system.

Initial set — the first setting action of mortar; the beginning of the set.

Insanitary — unhealthy; injurious to health.

Installation — act of establishing; the putting into effect of some system or device.

Interior decorations — those finishings and furnishings designed to give beauty to the inside appearance of a building.

Interlocking — the binding of particles one with another.

Intersect — to cross; when one line crosses another, it is said to intersect.

Intrados — the bottom edge or lower curve in the arch.

Inverted arches — arches which are built to appear upside down; made to distribute the weight from pier to pier, over an extended surface of the foundation bottom.

Iron — a mineral contained in the clay for brickmaking.

Israelites — Hebrews or Jews, the descendants of Jacob.

Jack arch — a flat arch.

Jamb — the side of an opening, such as a window or door.

Jointing — the process of facing the mortar joints.

Journeyman — a man fully skilled in a craft or trade; formerly a man who worked by the day.

Jurisdictional dispute — a dispute between two trades, as to which craft a certain kind of work belongs.

Keystone or brick — the center brick of the arch.

Kiln — a large oven, or heated chamber used for the purpose of hardening, burning, or drying anything.

Lap — the distance one brick extends over another.

Lateral thrust — the pressure of a load which extends to the sides.

Lavatory — a sanitary place where facilities are provided for washing and care of the person.

Lead — that part of the wall which is built as a guide for stringing the line and building the remaining part of the wall.

Legend — a picture or diagram accompanying a drawing to indicate the meaning of certain lines, marks, and symbols that are used in the drawing. It tells the story of the drawing.

Lintel — a horizontal piece of wood, iron, or steel, terra cotta, or concrete laid to span an opening and support the superstructure.

Lime — the base of mortar, and the result of limestone burned in a kiln until the carbon dioxide has been driven off.

Lineal — pertaining to the direction of a line.

Lineal foot — a foot measurement along a straight line.

Manganese — a mineral contained in the clay for brickmaking.

Mantel — the finish and face work around a fireplace.

Mantelshelf — that shelf over the fireplace which projects from the wall.

Manufacturing building — a building which is used for factory purposes.

Mechanical — pertaining to machinery, and certain laws of motion, called " Mechanics".

Mechanical product — an article or useful thing made through the skilled work of mechanics.

Middle Ages — the period following the fall of Roman power 476 A.D., and extending through the period of the 13th, 14th, and 15th centuries A.D. Its close is variously estimated.

Modern — pertaining to the present age; usually to present times.

Mortar — a mixture of lime and sand, or cement and sand, or of lime, cement, and sand, used for laying bricks and filling in the joints between them.

Mortar board — a board about 3 feet square laid on the scaffold to receive the mortar ready for the use of the bricklayer.

Mortar box — the box in which the mortar is mixed and softened by water for use.

Motion study — a study or a close analysis of the motions made by the bricklayer at work, with a view to eliminating those that are unnecessary and to discover those that will give the best results for the least expenditure of physical effort.

Neat cement — pure Portland cement, which is used as a mortar without adding sand.

Oblique — slanting.

Ornamentation — decoration; special features executed for ornate effects.

Outside four inches — the single tier of stretcher courses on the face of the wall.

Overhand work — is that work on the outside of the wall performed from the scaffold built on the inside of the wall.

Overhead costs — these costs of doing business which must be met in order to carry on the business, such as rent, interest on the capital invested, insurance, and the like.

Panel — a distinct or blocked out portion or section of a wall or some other surface.

Pargeting — a term meaning the process of plastering the inside of a chimney flue.

Particles — small parts, atoms.

Partition — a dividing wall.

Pattern — a design, pictured or made into a model, that can be imitated and repeated.

Pavement — a covering on the floor of bricks, stone, tiles, wooden blocks, or concrete.

Penetrating — entering and working through, as moisture works its way into a brick wall.

Perpendicular — pertaining to the upright, vertical.

Perpends — the vertical joints in the face of the wall when corresponding joints are plumb one over the other.

Perspective drawing — a representation on a plain surface, usually paper, of the actual appearance of a building of definite measurements as it would appear to the eye from an established point.

Philosopher — a lover of wisdom; a leader of thought.

Physical exertion — bodily effort, work of the muscles.

Pier — a block of brickwork usually between two openings which is built to support arches, or to carry beams or girders.

Pilaster — a pillar of brickwork, rectangular in form, built as a supplement to a pier, projecting usually one-third of the thickness of the wall.

Plan — a picture drawn to scale of the floor area of a building showing the position of the walls, windows, doors, and other like features.

Plaster cast — a mold picture or tablature of an artistic character, made out of plaster, usually to fit into a panel in the wall.

Plastic — in the form of a sticky paste.

Plumb bob — the lead weight to make taut the plumb line.

Pointing trowel — a small tool used for filling joints on the exposed surface of the wall.

Political — pertaining to affairs of city, state, or national governmental policy.

Political economy — that science which treats of the wealth-getting and wealth-using activities of men. Same as economics, which term is now more frequently used.

Portland cement — that cement made by a mixture of various clays, chalk, limestone, river mud, slate, and the like, which are mixed together, burned, then ground into a powder and put through a sieve with fine meshes.

Pressed bricks — those that are pressed in the mold by mechanical power before they are burned or baked.

Projection — that which sticks out from the surface or a given line, such as corbeling courses of bricks extending from the face of the wall.

Property — that for which a person may have a title to use and own, protected in that title by public authority.

Proportion — balance, or symmetry; a building is said to be in proportion when its parts harmonize.

Public building — a structure erected for public purposes, such as, government buildings, court houses, hospitals, auditoriums, monuments, and the like.

Putlog — the cross supports of the scaffold which hold the scaffold planks or platform.

Quantity survey — is the process of calculating the quantities of material and labor that go into a building.

Queen closer — a half brick made by cutting the brick lengthwise.

Racking — the method of building the end of the wall, or a lead by setting back each course to form a series of steps.

Raking bond — brick laid in an angular or zigzag fashion.

Rectangular — having one or more right angles, usually signifies a figure with four right angles.

Reinforced concrete — concrete which has iron and steel rods and pieces to enable it to withstand greater stress and strain.

Related trades — trades which directly depend upon, or grow out of, the one in question.

Residence — a house or home where one lives his private life, as distinguished from the business office, the factory, or workshop.

Rights — powers and privileges to have or enjoy, which are guaranteed by public authority.

Rise — the distance at the middle of the arch between the springing line and the intrados or soffit.

Roman Empire — the empire which was controlled by the government at Rome, an ancient Italian city. It was flourishing and powerful at the beginning of the Christian era.

Rowlock — rows of bricks on edge, particularly for the ring of an arch.

Running bond — same as stretcher bond.

Safety — the term used for all precautions taken to preserve life and limb.

Sag — a depression in a horizontal line, meaning that there is a slight fall below the level. Usually refers to the bricklayer's line, which in a long distance will fall below the level because of its own weight, no matter how tightly it is stretched.

Sand — small grain of mineral, largely quartz, which is the result of disintegration of rock.

Sanitation — that which pertains to sanitary conditions, or, in other words, preserves health.

Scaffold height — the height of the wall which requires another raising of the scaffold to continue the building of the wall.

Scale — a series of spaces set off by lines, representing proportionately larger distances.

Scant — a slight slope inwards from the plumb line.

Scientific — according to accepted knowledge; based upon the methods of systematizing and classifying principal facts and data.

Scutch — a tool resembling a pick on a small scale with flat cutting edges, for trimming bricks for particular uses.

Segmental arch — an arch whose intrados and extrados form the segment of a circle; in general terms a curved arch.

Semicircular arch — an arch whose soffit and extrados make the line of a half circle.

Semi-transparent — that which can be partially seen through.

Set — a name given for the chisel used for cutting bricks, called also a "bolster".

Shank — that part of the trowel between the blade and the handle or hold.

Silica — a mineral contained in the clay used for brickmaking.

Sill high — height for the window sills upon which the window frame rests.

Sketch — a preliminary drawing designed to picture an idea of an object; an illustration.

Skewback — the surface at each end of the arch upon which the first bricks are laid; the spring surface of the arch.

Skyscraper — a term used to characterize a very high building, whose top appears to scrape the sky.

Social life — that sphere of human activity which relates to the intercourse among individuals and groups of individuals.

Soffit — the lower edge or curve of the arch; also called "intrados".

Soluble salts — a mineral contained in the clay for brickmaking.

Span — the distance to be covered by an arch, lintel, beam, girder, or the like, between two abutments, or supports; the width of an opening.

Spandrel — the triangular portion of the wall contained between the arches when a horizontal line is drawn from crown to crown.

Specialization — synonymous with division of labor, means the devoting of one's attention in working on a particular or single line of work.

Specification — a statement of kind, quality, quantity, of work and materials that are to go into a building; usually accompanies working drawings.

Spirit plumb rule — a plumb rule made by the insertion in the wood stock of small tubes filled with spirits with an air bubble which is arranged to center at a point when the rule is in a plumb position.

Spreading mortar — the process of laying mortar on the wall with a trowel to make a bed in which to lay the brick.

Square foot — a foot measurement in two dimensions, measuring a foot long and a foot wide.

Squares — wood or steel instruments which make an angle of 90°.

Statutes — regularly enacted laws.

Steel cables — ropes made of steel wire.

Steel girder — a steel beam, or joist, designed to carry a heavy load.

Stippling — that process of shading by making separate marks or points.

Story high — the height for the floor joist.

Straight arch — a name for the jack, or flat arch.

Straightedge — a board having an edge trued and straight, used for leveling and plumbing.

Strategic — pertaining to the position in which a leader can obtain an advantage.

Stress — a very pronounced pressure.

Stretcher — a brick laid flat with the long edge to the face of the wall.

Story pole — a pole or piece of timber which has the height of the story marked upon it, and usually the height of sills and openings.

Structural steel — steel beams, girders, and columns used for building purposes, particularly for high buildings, known as skyscrapers.

Stucco — plastering on the outside of a wall with Portland cement mortar.

Superficial — upon the surface.

Superstructure — that part of a building which is above.

Symbolic masonry — work of a fraternal society usually called Free Masons, whose customs and practices grew out of the customs and practices in actual construction of building in ancient times.

Technical — pertaining to mechanical arts or any science, business, or the like.

Temper — to mix up so as to get the mortar in the proper condition for use.

Template — a pattern or guide.

Texture of brick — the looseness or compactness of the material of which the brick is made, which affects its appearance.

Theoretically — according to a process of reasoning.

Thermometer — that instrument by which the degrees of temperature are measured.

Three-quarter — means a brick with one end cut off; about a 6-inch piece.

Tier — a vertical layer of bricks four inches wide, — the width of one brick.

Tombs — burying places for the dead.

Toothing — the edge of a piece of brickwork which suggests teeth from the appearance, and left so as to offer the possibility of tying in the remaining wall to be built, with the idea of keeping the bond continuous.

Trade — a mechanical employment, or pursuit; a skilled craft.

Trade union — an organization of workmen of a particular trade or craft for the purposes of dealing collectively with their employers.

Transport or transportation — the system of carrying or removing objects or people from one place to another, such as railroading, shipping, aviation, and the like.

Trench — the ditch dug in the earth to contain the foundation wall.

Trestle horse — a four-legged stool or trestle about five feet high, used to support platforms for scaffolding.

Trig — the bricks laid in the middle of the wall between the two main leads to overcome the sag in the line, and also to keep the center plumb in case there is a wind bearing upon the line.

Trimmer arch — the arch which supports the hearth of a fireplace.

Troy — an ancient Grecian city in Asia Minor.

Two-inch piece — a quarter of a brick, a closer.

Utility — usefulness, or capacity to fulfill a useful purpose.

Vertical joints — a term for the cross joints of mortar between the ends of the bricks in the wall.

Viaducts — an elevated roadway usually supported by masonry arches, or steel columns and trusses; in recent years often made of reënforced concrete.

Vitrification — the state of a substance which is fused together by burning.

Vitrified — that which is fused by heat.

Voussoir — the unit brick, stone, or block used in the building of an arch.

Wage contract — the agreement between the employer and employee on the amount of wages to be paid for a particular kind of work, and on the other conditions of employment.

Wall plate — a piece of timber usually 2″ × 4″ laid on the wall to receive the floor joists.

Weathering — the process of decay brought about by the effects of weather conditions.

Working drawing — a drawing showing how certain parts are to be worked in detail.

Workmanship — the character of execution of a job.

Workmen's liability insurance — insurance to protect the employer whose workmen may be injured. This is done by paying a premium to an insurance company; the insurance company then pays the compensation award for the workman who is unfortunate enough to be hurt.

N.B. — The reader should consult a good dictionary for terms not included in the glossary. Among the well-known dictionaries are: Websters', Funk & Wagnalls', and the Standard; these as well as others are issued in smaller editions which form a handy reference for the reader.

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